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THE

JOURNAL OF SCIENCE.

APRIL, 1882.

I. ANIMAL AUTOMATISM.*

Communicated by ROBERT LEWINS, M.D.

THIS volume consists of a series of Addresses, Lectures, and Essays, which, as we learn from the short Preface, "have appeared at intervals during the past seven years." It is needless to say that we have here many examples of that profound scientific knowledge, set forth in accurate and pellucid language, which is associated with the name of its author. The welcome task of commendation is indeed so superfluous that, were no flaws discoverable, the book need hardly be reviewed at all, but might be left to make itself appreciated, like the sun, by its own inherent lustre. Happily a few faults afford us an excuse for referring to its many merits; and since the latter will be speedily discovered by all who read it, and taken for granted by all who do not, we may feel ourselves justified in dilating chiefly upon the former.

The two articles which call for special remark are respectively entitled "On the Hypothesis that Animals are Automata, and its History," and "On Sensation, and the Unity of Structure of Sensiferous Organs." In both we find exact statement and luminous exposition, which can scarcely be misunderstood save by the most obtuse or careless reader; yet in both the negative conclusions drawn from positive premises appear illogical and unsatisfactory. Prof. Huxley reminds us of the allegorist who, after relating his story with the utmost verisimilitude, disenchants us at the end by

* Science and Culture, and other Essays. By THOMAS HENRY HUXLEY, LL.D., F.R.S. London: Macmillan and Co.

his "Then I awoke, and behold, it was a dream." In the one essay, he traces the progress of an excitation from the peripheral end of the afferent nerve to its termination in the "sensifacient" sensorium; and in the other, shows how the stimulus is reflected through the grey matter of the brain or spinal cord to the efferent nerve. These processes he describes throughout "in terms of matter and motion," leaving no room for the intervention of any spiritual Archæus. Yet at last we are left in doubt whether this creative cerebrum may not after all be a mere phantom, evoked by the Archæus itself.

The whole discussion of Descartes's theory of "Animal Automatism" tends to prove that the human organism is a self-acting machine, differing from the lowest forms of life only in its greater complexity. It is simply a watch, supplied with a mechanical contrivance by which it can wind itself up and manufacture other watches. We are told that "modern physiology, aided by pathology, . . . proves, directly, that those states of consciousness which we call sensations are the immediate consequents of a change in the brain excited by the sensory nerves, and, on the well-known effects of injuries, of stimulants, and of narcotics, it bases the conclusion that thought and emotion are, in like manner, the consequents of physical antecedents." Undoubted examples of complicated and seemingly rational reflex action, in man and other animals, are dwelt upon at some length; and in order to examine the train of reasoning which runs through the greater part of this essay, it will here be necessary briefly to recapitulate certain well-worn physiological facts.

If the spinal cord of a human being be divided at any point, those parts of the body supplied with sensory nerves having their origin below the division are absolutely deprived of sensation, but remain capable of apparently purposive motions in response to stimuli. The same holds good of a frog similarly mutilated, but in this case we are able to carry the experiment a step farther. If, without injuring the spinal cord, we remove "the foremost two-thirds of the brain," the animal will jump or walk when irritated, and swim if thrown into the water, but is absolutely devoid of any spontaneity." The inference is "that the impression made upon the sensory nerves of the skin of the frog by the contact with the water into which it is thrown, causes the transmission to the central nervous apparatus of an impulse, which sets going a certain machinery by which all the muscles of swimming are brought into play in due co-

ordination." If we remove only the anterior division of the brain lying in front of the optic lobes, the frog is still blind, deaf, and destitute of volition. Yet if the plane on which he is seated be inclined, he will change his position so as to save himself from falling, and, though he cannot see, will yet avoid any object placed between his head and the light, by passing to the right or left of it. "Although the frog, therefore, appears to have no sensation of light, visible objects act through its brain upon the motor mechanism of its body." Consciousness, then, cannot be regarded as the cause of "voluntary" motion, but only as its frequent concomitant. This inference is further supported by the remarkable case of a French sergeant, who, in consequence of a serious injury to the brain, became subject to periodical trances, during which he pursued his usual avocations, but was apparently destitute of spontaneity and sentience. Though he ate, drank, smoked, and even wrote letters, he was totally insensible to pain, or to any physical impressions, with the doubtful exception of impressions of touch. We come naturally to the conclusion that "the argumentation which applies to brutes holds equally good of men; and, therefore, that all states of consciousness in us, as in them, are immediately caused by molecular changes of the brain-substance. . . . The feeling we call volition is not the cause of a voluntary act, but the symbol of that state of the brain which is the immediate cause of that act." It is surely clear that "we have as much reason for regarding the modes of motion of the nervous system as the cause of the state of consciousness, as we have for regarding any event as the cause of another."

In the essay on "Sensation and the Sensiferous Organs" we find facts not less decisive and utterances not less unequivocal. The creative power of our material organisation is fully recognised in a sentence like the following:—"The epithelium may be said to be receptive, the nerve-fibres transmissive, and the sensorium sensifacient," the last word being, as we shall see later, of especial importance. "The sensiferous apparatuses are, as it were, factories, all of which, at the one end, receive raw materials of a similar kind,—namely, modes of motion,—while, at the other, each turns out a special product—the feeling which constitutes the kind of sensation characteristic of it."

But if we here take breath, and hope to be allowed to repose in a logical and consistent Monism, we shall be greatly mistaken. Though the brain is sense-creating, and therefore world-creating; though, "so far as we know, the

change in the sensorium is the cause of the sensation," we are now gravely called upon to doubt the existence of matter, and consequently that of the material encephalon, thus admitting all our previous conclusions to be null, void, and absolutely meaningless. We are presented with three hypotheses, corresponding to Animism, Materialism, and Pre-established Harmony, and are told that all stand on the same footing, and that the superiority of the second consists solely in its simplicity and convenience. It has been previously hinted* that no adherents of the third doctrine now exist, and in a former work the first is thus contemptuously dismissed, as unworthy of serious attention and inferior to the most shallow Materialism. "Cabanis may have made use of crude and misleading phraseology when he said that the brain secretes thought as the liver secretes bile; but the conception which that much-abused phrase embodies is, nevertheless, far more consistent with fact than the popular notion that the mind is a metaphysical entity seated in the head, but as independent of the brain as a telegraph operator is of his instrument.† In the concluding article of the present volume, on "The Connection of the Biological Sciences with Medicine," we also find that "the essence of modern, as contrasted with ancient, physiological science, appears . . . to lie in its antagonism to animistic hypotheses and animistic phraseology."

Obviously we have not to join issue with Pre-established Harmony, or with orthodox Dualism, but with what may be denominated Absolute Agnosticism, and which, if logically carried out, would be as fatal to science as it is to philosophy. There can be no doubt that matter, as we know it, "is the hypothetical substance of physical phenomena—the assumption of the existence of which is as pure a piece of metaphysical speculation as is that of the existence of the substance of mind." Yet it may be possible to show that the existence of both is a necessary postulate of valid thought, which can only attain consistency when it reaches the further proposition, that these apparent two are in reality one. In truth, the whole question may be settled by an appeal to Descartes's primary axiom "*Cogito, ergo sum*," which is no mere *petitio principii*, as its critics have erroneously assumed. This will be clear from the following considerations.

A perception, or mental phenomenon, cannot be supposed to possess any energy or power of action. As a mere *appearance* it can obviously only *appear* to act, or to produce any

* Page 234.
† Life of Hume, p. 80.

effect. What we regard as a mind in action will—according to Absolute Agnosticism—be only a succession of separate and distinct mental phenomena, not even causally related, since causality is only an inference from observed connection. But if so, there can be no such thing as the development of a conclusion from premises, and consequently a logical chain of reasoning will be impossible. Now when a "heap or collection of different perceptions"* examines itself, and finds its supposed substance in all probability non-existent, its arguments are either valid or fallacious. If valid the "heap" has a more than phenomenal existence, and the arguments again fall to the ground. Universal scepticism thus places itself in the same dilemma as Epimenides the Cretan, when he asserted that all the Cretans were liars. This applies not to Hume's philosophy, but to popular misconceptions of his true meaning, which is clearly stated in the following passage:—"Thus the sceptic still continues to reason and believe, even though he asserts that he cannot defend his reason by reason; and by the same rule he must assent to the principle concerning the existence of body,† though he cannot pretend, by any arguments of philosophy, to maintain its veracity. . . . We may well ask, *What causes us to believe in the existence of body?* but it is in vain to ask *Whether there be body or not?* That is a point which we must take for granted in all our reasonings."‡ Hume's real aim was the demonstration that the basis of reason cannot be derived from reason itself. Certain primary assumptions, not philosophically proved, but justified by intuition and experience, are necessities alike of abstract thought and practical conduct. This does not, of course, apply to hypotheses such as Animism, which can be contested by non-suicidal arguments.

The existence of a material proplasm of mind is implied by Prof. Huxley when he describes the sensorium as "sensifacient," and consequently prior to the sensations which it creates. Yet, though we are forced to believe in "mind-stuff," does this in any way prove the reality of matter? Since "our sensations, our pleasures, our pains, and the relation of these, make up the sum total of the elements of positive, unquestionable knowledge," may not the seemingly creative brain be itself a creation of the mind? No man can examine and experiment upon his own cerebral organ;

* HUME's Treatise of Human Nature, Book I., Part IV., Section 2.

† The word "body" is here used as synonymous with *substance*, either of mind or matter.

‡ *Ibid.*

and the mass of grey and white matter which the brain of another presents to him, is, like the rest of the "external world," a mere subjective phenomenon. But each individual is justified by analogy in assuming the existence of other individuals, who manifest their thoughts and sensations in the same way in which he manifests his own. The physiologist or physician is therefore practically an observer of two sets of phenomena—those which belong to the physical frame of the patient, and those which belong to his mental constitution. The latter kind of observation is, of course, only mediately possible; but the facts of which it takes note may be sufficiently interpreted by the experience and self-knowledge of the investigator. He will discover that all changes in the latter class are preceded by certain definite changes in the former, and will at length arrive at the conclusion that the mind "is really a system of effects, the causes of which are to be sought in antecedent changes of the matter of the brain." * He will next remember that, as shown above, every thinker is forced to postulate the reality of "mind-stuff,"—that is, of a matrix which generates the phenomena of sensation and thought. If not misled by genius, he will see the necessity of ascribing the invariably preceding phenomena of matter and motion to the same creative proplasm, since he is not entitled to assume the existence of any other. Since these latter phenomena are by common consent called material, he is justified in assigning to the proplasm of mind the familiar name of matter. Thus we may say of the brain, "*Cogitat, ergo est.*"

This monistic view is preferable, not merely from its convenience as a "working hypothesis," but because it contents itself with asserting the being of that matrix whose non-being is unthinkable, and declines to take any note of an "immaterial substance," for the existence of which, as Prof. Huxley admits, not a particle of demonstrative evidence can be offered. The attitude of a Materialist towards the "*anima*" is that of every modern astronomer towards those planetary genii, or "ruling spirits," which were finally disestablished by Kepler from their crystal spheres. The existence of such beings "cannot possibly be disproved," and no reason can be given for disbelief in them, save their total superfluity.

Let us, then, assume our material proplasm as the *vera causa* of mental and physical phenomena, and see how this theory agrees with recognised facts. In the first place, we

* Life of Hume, p. 78.

find that it is the very basis of medical science, and that every ordinary practitioner who has ever attended a dyspeptic or hypochondriacal patient knows that he can only minister to the mind by ministering to the body. If he were treating simply a phantasmal apparition, there could be no result, save in his own inner consciousness; but since his remedies do produce a result in the inner consciousness of his patient, it is clear that the physical frame upon which they have acted, so far from being unreal, is the only reality with which he is practically concerned.

The effects of the food which is daily transubstantiated by the incarnating digestive organs,* and the atrophy of mind and body which follow prolonged abstinence, prove alike the real existence of the material universe and its complete homogeneity with our own being.

Prof. Huxley states that he is "utterly incapable of conceiving the existence of matter, if there is no mind in which to picture that existence." Here, as elsewhere, he confounds material phenomena, which cannot exist without a percipient mind, with matter itself. Unless his views have recently undergone a marvellous change, he holds that the earth was in being very long before the appearance of any sentient organism. Will he now maintain that this æonial existence depended upon a picture formed in some mind, Supreme or otherwise? In his work on "Man's Place in Nature" he expressly asserts his conviction that mind is developed from matter, and that "even the highest faculties of feeling and of intellect begin to germinate in lower forms of life." According to his present theory, nothing whatever could have existed previously to this germination—not mind, since it was as yet unborn; not matter, since there was no mind in which it could be pictured. In fact there could have been no "lower forms of life," and therefore no germination!

The existence of matter may now be regarded as a theoretical and practical necessity, and the only question which remains is this—Can a separable spiritual essence be considered absolutely superfluous, or must the "dead matter" of the universe be inspired with energy from some external source before it can fashion itself into living and sentient organisms? Let us turn for information to Prof. Huxley himself. "If," he says, "there is any truth in the received doctrines of physics, that contrast between living and inert

* Digestion (concoction), a pre-scientific—indeed anti-scientific—term, is, in correct phraseology, now superseded by the term assimilation, *i.e.*, the process of *asselfing*, or incorporating with Self objects of Not Self, thus indicating the essential consubstantiality of subject and object.—R. L.

matter, on which Bichat lays so much stress, does not exist. In Nature nothing is at rest, nothing is amorphous; the simplest particle of that which men in their blindness are pleased to call 'brute matter' is a vast aggregate of molecular mechanisms performing complicated movements of immense rapidity, and sensitively adjusting themselves to every change in the surrounding world. Living matter differs from other matter in degree, and not in kind; the microcosm repeats the macrocosm; and one chain of causation connects the nebulous original of suns and planetary systems with the protoplasmic foundation of life and organisation." * We have, then, a substance to which all known manifestations of cosmic and vital energy can be traced, and beyond which we can never penetrate. No independent principle of life is needed to vivify what is already vital: no basis of mind is necessary save that cerebral tissue which originates and conditions the facts of consciousness. We may say, in the pregnant words quoted by our author from Descartes, "So far as these [functions of mind and body] are concerned, it is not necessary to conceive any other vegetative or sensitive soul, nor any other principle of motion or of life, than the blood and the spirits agitated by the fire which burns continually in the heart, and which is nowise essentially different from all the fires which exist in inanimate bodies." The minor physiological inaccuracies of this sentence in no way detract from its fundamental truth.

In taking leave of this very instructive volume, we may, in the same breath, justify its author and the "common-sense philosopher" whom he so sternly rebukes. Far from cavilling at Reid's maxim, that "it is genius, and not the want of it, that adulterates philosophy, and fills it with error and false theory," we gladly welcome it, as accounting, in a pleasing and rational matter, for certain deviations from sound sense and logical reasoning which we discover even in the writings of so distinguished a *savant* as Professor Huxley.

C. N.

NOTE.—As further evidence that the philosophic and scientific Materialism advocated in the above article is ratified by contemporary Medicine, let me be allowed to quote the following extract from a "Defence of Vivisection," by Sir William W. Gull, in the current (February) number of the "Nineteenth Century." At page 457 that high practical authority writes—"Until to-day the theory that the living

* Science and Culture, p. 347.

quality in us was due to a mysterious vital force [*i.e., immaterial spirit or principle*], out of the reach of Science, preoccupied the mind, and stood in the way of observation and experiment. But now it has become the immovable standpoint of physiology that a living creature is dependent for all its bodily functions upon the forces of inorganic matter; in other words, that our corporeal life is but the operation of material atoms and material forces within the reach of experimental enquiry." Comment upon this authoritative negation of spiritual agency in vital action seems superfluous.—R. L.

I. THE "SPECIES" WAR REOPENED.*

NOW that the doctrine of Evolution is generally accepted by competent authorities, and now men of Science are settling undisturbed to the serious task of examining in detail how existing forms have arisen, they will doubtless feel no little surprise at a reopening of the original question. Yet this is actually done in the two treatises before us, though it must be admitted in a very different manner, and with very different degrees of ability.

Mr. Newton Crosland writes in "Light," the accredited organ of the Spiritualists. We regret to perceive that this body seem to be entering upon a career of aggressive war against biological science. A few weeks ago there appeared in the same paper, under the *ad captandum* title "Violationism, or Sorcery in Science," a hysterical onslaught on physiological experimentation, cunningly enough designed to arouse the fanaticism of the vulgar. Now we have an attack upon "Darwinism," in which the author demonstrates at least two things—his intense animus against the Evolutionist doctrine, and his utter incapacity to deal with the question. In proof of this charge we need merely quote the following sentence:—"Darwinism professes to expound some of the most important difficulties and aspects of Creation by a theory of Evolution based upon three (!) principles, termed—1, the struggle for existence; 2, natural selection;

* Permanence and Evolution: an Inquiry into the supposed Mutability of Animal Types, by S. E. BOUVERIE-PUSEY. London: Kegan Paul, Trench, and Co.

Darwinism, by NEWTON CROSLAND.—"Light," for February 25th, 1882.

and 3, the survival of the fittest." To find one agency thus classified and discussed as three may well astonish the reader.

Mr. Crosland writes: "In a recent number of 'Knowledge'—a publication so named on the *lucus a non lucendo* principle, I presume—there is a review of a book by Sir E. Beckett on this subject of Darwinism, in which the author very satisfactorily shows that the spider must have made its web complete from the first, otherwise it would be useless." If Sir E. Beckett and Mr. Newton Crosland had been in the habit of observing spiders they would have seen that even very rudimentary webs are of great service. Those species which leap upon their prey secure themselves by means of a single line, so that if they miss their spring they are in no danger of falling, We must further remind this writer and Mr. Mortimer Collins, from whom he borrows a flippant motto, that Evolutionism and Positivism are not identical. Comte, the founder of the latter doctrine, was a firm believer in the permanence of organic species. Here, however, we must dismiss Mr. Crosland. If he wishes to discuss this subject we would recommend him to devote, say, ten years to the serious study of animal or vegetable life, not in books, but in the museum, in the laboratory, and, above all, in the fields and woods. At present he is rich chiefly in that attribute against which the gods themselves are powerless.

Mr. Bouverie-Pusey is a writer of a very different class. He has evidently given the question prolonged and close attention. He does not invoke the *odium theologicum*. We find in his work no assumption of the perfection of Nature, no outburst of horror at the suggestion of man's possible blood-relationship to apes, no assertion of mechanical creation,—nothing, in fact, of the Old School of Natural History or of the stock-in-trade of anti-Darwinian controversialists. His aim is not so much to set aside Evolutionism as to pronounce its formal acceptance premature. He is for suspending judgment. As to how species were originally produced "we must be content to own that we know nothing." Again, in the last sentence of the book, we read —"All these considerations impress upon us more and more that the origin of organic types is at present, and till we have some new knowledge enabling us to attack the problem in quite a different manner, an insoluble mystery." Here, then, we have a conclusion certainly free from rashness and presumption, and we cannot refuse our tribute of respect to a writer who, in an age of over-hasty speculation, evinces such judicial caution.

The first point we notice is that Mr. Pusey, whilst maintaining the permanence of types, rejects the notion of species. He writes:—"Whatever else becomes of Darwin's labours, the conventional notion of species which includes together all human beings, and at the same time separates the wolf from the jackal, can never be built up again." He contends that the conventional idea of species is the "antipodes of a clear idea, combining as it does the notions of origin from one stock, real or possible; existence in a wild state, even in separate areas; fertile reproduction *inter se*, breeding together naturally without human interference, and a certain undetermined degree of likeness." There is no subject indeed on which naturalists differ more hopelessly than on the number of species of a certain group which exist in some given area. If we ask a number of botanists how many native species of roses occur in Britain, we shall receive very discordant answers. Turn to the entomologists, and question them as to the species of true dung-beetles (*Geotrupes*) found in this country: some will reply two only, some three, some nine, besides a variety or two! Hence we have among naturalists two parties, known by the inelegant names of "lumpers" and "splitters." The former are accused of overlooking weighty distinctions, whilst the latter are said to invent differences where none exist. The ordinary conclusion drawn from this difficulty, or rather impossibility, of defining strictly what should constitute a species, is that the forms of organic beings flow into each other continuously, and that hence the transmutation of species is the more probable. Mr. Pusey draws a different inference. We all know the weight laid by French anti-evolutionist writers upon the so-called "Egyptian" argument for the permanence of species,—the fact, or alleged fact, that the mummies and skeletons of certain domestic animals found in the catacombs differ not appreciably in structure from specimens of the same kind living in the present day. We know, further, the reply that this argument, if anything at all, proves too much, since, according to similar Egyptian evidence, races of mankind and breeds of cattle were as mutually distinct as they are in this nineteenth century. To the Old School of Natural History, who—whilst maintaining the permanence and distinct origin of species—consider that races, breeds, and strains have been formed by what is at bottom a process of Evolution, this reply is fatal. But Mr. Pusey pronounces the variety, the race, the strain, also permanent. He finds "no difficulty in believing that at the first formation of animals there existed, independently, not

only what we happen to call distinct species, but also sub-breeds and strains still more faintly characterised." This is in some respects a novel departure in natural history, exactly antipodal to the Evolutionist supposition that all animals are ultimately descended from one common stock. Anti-Darwinians contend, *con strepitu*, that we can produce no evidence of a gorilla or a mias developing into a man. But neither have we on record any well-authenticated instance of a white man or woman being born from any pure negro stock, or *vice versa*. So that Mr. Pusey cannot be confuted by direct evidence. The believers in the independent origin of species who assume that each is the issue of one primordial pair cannot confute him, for they are incapable of accounting for the origin of varieties and races without making dangerous admissions.

To this doctrine of permanence it is replied by Evolutionists that the evidence in its support is purely negative. No one, perhaps, has seen a novel animal type developed from one pre-existing. But no one has seen a new type originate in any other way. Yet that different series of forms have successively appeared upon the earth appears certain. Whence then, and how? The Evolutionist view, however unsupported by direct evidence, seems at any rate more conceivable than the equally unsupported view of independent origin. For whether is more likely, that an existing form should give birth to descendants more or less modified, than that new forms should arise out of the earth or be condensed from the air? We may venture to say that if any five or ten educated and reputedly truthful men were to make affidavit that they had witnessed such an occurrence, they would be simply laughed at, and that by believers in independent origination not less than by evolutionists. Had we the misfortune to witness such an event we should conclude ourselves the victim of an illusion, or else we should be forced to admit that Science was henceforth an impossibility because Nature was without order. And no third alternative can be supposed. Evolution or independent origin; it is Hobson's choice. In what way either is supposed to have been effected does not here come into consideration. Mr. Pusey admits that Evolution is more conceivable than production in any other way. But he seeks to set this admission aside by the following illustration:—"It would seem to the eye of a layman (and with regard to the origin of life we are all laymen) easier to make one salt out of another closely resembling it than out of an acid and a base which do not resemble it at all. Yet we

know that the one is possible, and the other supremely impossible. So to a savage it would no doubt seem easier to turn, say, a watch on the Swiss horizontal principle into an English chronometer than to make the last anew out of bare metals; yet in point of fact the Swiss watch, as such, could not be converted, but would have to be entirely reconstructed." This is exceedingly acute, but we think that the analogy here put forward is open to question. We are not all laymen as regards the constitution, mechanical and chemical, of animals. The supposed man who thinks two salts convertible merely from an external similarity is not fairly comparable to the naturalist who, having minutely dissected two animals and analysed their tissues, finds them substantially identical. The supposed salts are not convertible because the one contains some element which the other lacks. Between, say, the horse and the ass there is no such difference, chemical, morphological, or physiological. The Swiss and the English watches, again,—even to the eye of a man who, like ourselves, is totally ignorant of watch-making, contain respectively different structural elements.

The author makes the following suggestion:—"Let us suppose that organised beings are merely chemical products of excessive complexity,—of complexity proportioned to their elevation as organisms,—and whose systematic affinity is dependent on the resemblance between their elements; and that the excessive rarity of their appearance *de novo* on this planet arises from the complexity, and consequent rarity, of the collocations of matter necessary to produce them; this hypothesis, though totally without positive evidence to support it,—and I certainly do not mean to propose or defend it,—is in itself quite as clear and definite, and explains the facts as well, as the hypothesis of Evolution."

The hypothesis here sketched involves abiogenesis, or spontaneous generation, not of minute and relatively simple creatures, but of the largest and most complicated forms of life. How are the various elements necessary to form, *e.g.*, a full-grown ox or a horse, to be brought together in sufficient quantity? How are they to be wrested from the simpler and more stable inorganic compounds in which they are present? and how combined, not merely into such bodies as albumen, but formed into organic tissues? We know of no force, no form of energy, capable of at all approaching this task. If such a force existed we do not see why, acting as it must upon the same elements, it should not yield results always alike. Further, if species are to be produced in

this manner, at least two individuals, one of each sex, must appear at the same time and place.

The author more than once seeks to show a close analogy between animals and crystals, and to argue from the one to the other. But the transmutation of metals, or of crystals were it possible, would be a phenomenon of a totally different order from organic Evolution, and the two could throw no light upon each other. No one suggests that the mature animal or plant ever passes into some other type. The followers of Darwin suppose merely that it may produce a progeny varying more or less from itself. Now the crystal has no vital cycle, and is not reproductive. Here, therefore, the comparison breaks down.

Mr. Pusey, in dealing with the palæontological evidence, pronounces it "possible, however unlikely, that some day we may find a true horse contemporary with Orohippus." Be it so: it will be time enough to deal with such a phenomenon when it arises.

The author refers, in passing, to the attempts made by Sir W. Thomson and other physicists to limit the Earth's past duration. When it can be shown that the data upon which their calculations are founded are anything better than arbitrary assumptions, it will be early enough to regard them in any other light than as mathematical exercises.

The theory of "Sexual Selection," as supported by Mr. Grant Allen, is severely but ably criticised. Why, the author asks, are grass-eating Mammalia never green? If animals are attracted by the colour of their food we might expect cattle, sheep, deer, &c., to be predominantly green. "The thing which requires to be accounted for is not simply the presence of bright, but the presence of various different bright colours, arranged often in beautifully different patterns, separately characteristic of different living forms."

Many of the author's strictures on "Natural Selection" are very just. In common with most naturalists of the Evolutionist school, he fully recognises that such selection may preserve types possessing some distinctively advantageous feature, but can originate nothing. He remarks that in the highest, and therefore according to Darwin the latest developed of brutes,—to wit, the anthropoid apes,—"we find considerably lower fertility than in most other animals, and a longer period of infancy compared with the whole life of the creature. So that these high Primates must have lost instead of gaining (as far as the struggle for existence is concerned) in the course of their development out of lower types." It is further urged that the higher

animals altogether are inferior to the lower in fecundity, in hardiness, and in earliness of maturity,—in short, in the very points which Natural Selection would have developed. "These characters are of such a nature that they would remain beneficial to the creature under any conceivable change of circumstances." The author even adds, "An hypothesis of retrogression would probably be more consistent with natural selection than one of progress." This view—which by the way has been adopted by an American author—Mr. Pusey considers incompatible with the palæontological and ontological evidence.

From the following passage we must express our dissent *in toto* :—"In one most important part of the animal kingdom, however, a consistent evolutionist will be forced by ontogeny to assume retrogression where progress has hitherto been assumed. I allude to the anthropoid apes whose young are much more like man than the adults are afterwards; and we must therefore suppose, unless we give up the idea hitherto maintained by nearly all Evolutionists, and which is one of the main bulwarks of the development theory, that the growth of the individual pictures in miniature the growth of the race,—we must suppose that these are degenerated from a human or semi-human condition." The facts of the case are thus: the infant mias and the infant man are more like each other than the adults of the two species. As they grow older they are developed in different directions, and consequently diverge from each other—a phenomenon which to us seems strong evidence in favour of Evolution, and of which the study of embryology affords countless instances, species glaringly unlike when mature being with difficulty distinguishable in the early stages of fœtal existence.

In animal geography the author is not always a safe guide. He writes—"But New Zealand is not properly an oceanic island. It was recently connected with Australia. Then why has it no native mammal instead of being full of marsupials?" But though New Zealand was at one time doubtless much more extensive than it now is, the whole character of its Fauna and Flora negatives the supposition that it has been recently connected with Australia. For instance, while Australia abounds in serpents, New Zealand has none. Mr. Pusey says—"Since the time when Darwin wrote that Batrachia were never found in oceanic islands tree-frogs have been identified in the Fiji group. The same [what ?] may be said of the land tortoises of the Galapagos. But the most instructive instance in this respect, perhaps, is that

of the West Indies. There we have a marked insular fauna, almost no mammals that are indigenous (although cattle and goats have flourished and become feral under European auspices), but an enormous profusion of land-shells, surely as difficult to transport as mammals. It would seem that there must be some cause tending to extinguish mammals on islands after a certain lapse of time, though they do well enough for a short period." Tree-frogs and land-shells, though they possess but limited powers of locomotion, are very liable to be introduced by drift timber, and when once housed in localities such as, *e.g.*, the Antilles, where they have few enemies, they may be expected to multiply not merely in individuals, but in species. To refute the notion of a cause tending to extirpate mammals in islands, we need only look at the Eastern Archipelago. Java and Sumatra do not differ greatly in area from Cuba and Haiti. In climate and productions there is great similarity. Yet Java has ninety species of indigenous mammals. Compare this with Cuba! Yet the probability of extirpation by human agency must be much greater in Java. It has throughout good roads, a more ancient civilisation, a denser population, and a more energetic Government. Surely, then, if in addition to these varied agencies there were some general and unknown cause tending to extinguish mammals on islands, its fauna ought to be at least equally poor with that of Cuba.

We fully agree with Mr. Pusey's advice that we should find out by actual experiment what changes can be produced in a pure strain, and how, and that we should further seek to obtain a "knowledge of the mode of action, if not of the nature of the forces by which the formation and precise arrangement of the several parts of the mechanism of an organism are determined, as well as of those laws under the influence of which one creature, say, is caused to be of one colour, while another—in other respects very closely allied—has a different colour imposed upon its corresponding textures, and so with regard to other characters." At the same time, whilst admitting the necessity of such researches, we must remind Mr. Pusey that work of this kind is being carefully executed by not a few naturalists of merit.

We are very far from considering that every point of the new Natural History has been fully demonstrated. We are only too conscious that with many enquirers zeal has outrun knowledge, and that conjectures have been accepted for established truth. But for this unsatisfactory state of things the best remedy is, we submit, to test the Evolution hypothesis in actual work.

Mr. Pusey's book may be recommended to all naturalists who are desirous of rendering a reason for each and all of their tenets.

III. SCIENCE AND THE SENSE OF BEAUTY.

By J. MUNRO, C.E.

> "Let knowledge grow from more to more,
> But more of reverence in us dwell;
> That mind and soul, according well,
> May make one music as before."

THE study of pure Science tends in a measure not only to lessen our sense of the beauty of external Nature, but to dispel that reverent spirit in which we should regard each other and the wonderful universe in which we dwell. In the young prime of the world, before the era of positive Science, Nature could not but be viewed with unchecked feelings. She was looked at with the eye of the poet and the artist. Her beautiful forms and colours inspired delight and wonder: the play of her varied energies invoked sympathetic moods and feelings in the soul. Both sentiment and fancy were free. Imagination ran riot at will, and gave birth to Superstition. The flaming sun, the blue air and gorgeous clouds, the resplendent hues of verdure and flowers, the mixed scenery of rocks, woods, and waters, were not only beautiful, but mysterious. They possessed the mystery of a vision, they were the Creator's dream; earth was a Paradise conceived by the Divine imagination. The soul felt the mysterious influences of Nature, who seemed herself to have a soul. The woods and groves were peopled by idyllic beings of celestial purity. Superstition, sprung from awe and reverence, attributed occult effects to supernatural causes. Minds naturally philosophic attempted to account for all things out of their inner consciousness, and propounded systems which show how much poetry entered into their views of Man and Nature. The positive science which did exist was merely empirical—detached links of the chain of observed facts which would in future ages be laboriously forged into great generalisations.

The student of modern Science is led by patient observation and experiment into the details of Nature. He is no longer viewing the great masses of the heavens and endeavouring to solve the riddle of their mysterious motions. He is busy investigating the component particles of their large masses. The discovery of gravitation has silenced the music of the spheres, and the spectroscope has put their ancient divinity to flight. The sun is seen to be a blazing fire of the chemical elements, giving out its central heat to surrounding planets; the stars are more distant suns; the nebulæ are fiery clouds of incandescent gas. All bodies, whether on earth or in the heavens, are known to be compounded of small pieces of matter called atoms. All the atoms of one substance—carbon, oxygen, gold—are alike, and have the same properties wherever found. By close observation and laborious experiment these properties are slowly discovered. When he has made himself master of their secret, the chemist is able to reproduce for himself, in his laboratory, the phenomena of Nature which are due to the combinations and decompositions of these molecules. He can even go farther, and create for himself new substances, crystals, airs, and liquids, never found on the earth, and perhaps existing nowhere else. Such experiments—which are never failing, never capricious, but always yield the same result when the same preparations have been made—impress upon the mind of the scientist the conviction that atoms are endowed with certain inherent properties which never alter in degree or kind. In all the numberless experiments which are constantly being made, there is not a vestige of evidence to show that an ultimate particle has ever perished. On the contrary, the grand results of modern chemistry are built upon the faith that matter is indestructible.

Besides matter itself, the modern student of Science has to deal with the motions of matter. Heat, light, electricity, magnetism, sound, and sensation, are all accompanied by molecular motion; they are all manifestations of energy. Profound research has shown that this motion is never lost; it may change its form, but it is never destroyed, nor can it be created by man. Heat-energy may be transformed into electricity, electricity into magnetism, magnetism into sound or light, and these again into sensation; but the sum of the energy, through all its varied transformations, is known to remain the same. The modern science of physics rests on the belief that energy is indestructible. These two great generalisations are the recent results of our positive Science. In contemplating them the student comes to look upon the

fabric of Nature, with all its infinite variety of form and change, as an infinitely complex structure of atoms, built up by energy. He is led to regard the universe as being in incessant motion,—a *living* machine, it is true, but a machine still, and only the more complex because of its life.

The early philosophers of the seventeenth century, and even of the eighteenth, were unacquainted with these important generalisations. Even Newton probably did not divine them. The study of the heavenly bodies, in their dimensions and evolutions, is conducive to grandeur of imagination, and the early astronomers had not yet learned to investigate them in detail by means of the spectroscope. Young, Franklin, and Priestley, conducted their pioneer experiments with a sense of religious reverence. Newton likened himself to a child picking up shells by the sea-shore, while the great ocean of Truth rolled before him. To these men, at least, Nature was still robed in mystery. We have trafficked with her a great deal since those days, and she has become more familiar to our vain minds. By occupying ourselves so much with the little we have learned to understand of her, we are insensible to what is still beyond our knowledge. By classifying the shells in the bay we have lost some respect for the ocean still unexplored.

Yet there is a lofty poetry in the wonderful revelations of Science,—a poetry felt by Newton, Herschel, Faraday, and perhaps by all great discoverers. It is still sometimes felt by the student as he pursues his studies into fresh fields. If, then, we have lost a reverent sense for the marvels we are familiar with, we should rather attribute it to the triteness of our knowledge than to the character of that knowledge in itself.

One of the consequences of a scientific view of life and the phenomena of nature is a certain tendency to Paganism, but without its religion of ideal beauty. According to Science we are subject to the natural laws of our nature and dwelling-place. We live, like the hyssop on the wall, because we are strong enough to withstand the mechanical powers of the universe arrayed against us. Evolution accounts for our existence and maintenance, in the same way as it accounts for the existence of the lower animals. It discovers our immediate origin in the anthropoid apes, from which we are removed by a higher development of similar powers. If we brood too much on this kinship with the brutes, we shall be in danger of losing our subjective sense of the delicacy and grace of life. The beauty of life, for its own sake, will be taken from us, and there will be a tendency

to animalism in our thoughts. We shall feel lowered towards the brutes from which it is said we are sprung, and we shall seek to justify a sensuous existence. Young anatomists often suffer from a morbid view of life engendered by their studies. They lose their old reverence for the human body, and the delicate charm of life is marred by the ghastly sights of the dissecting-room. So, in these present days, many a susceptible youth is haunted by the spectre of protoplasm. Even the beauty of human beings is not strong enough to purify his tainted imagination, for it, too, is only a painted protoplasm in his jaundiced sight.

Our free and healthy sense of the beauty of Nature is undoubtedly to some degree sapped by the close study of Science. "Here's confusion to Newton," was the toast of the poet Keats one evening, in company with Haydon and Wordsworth, "because he has taken away the poetry of the rainbow." Newton decomposed the sunbeam into its primitive colours, and led to the explanation by Descartes of the rainbow. The loveliest thing on earth, the bow of promise round which beautiful legends had clustered from immemorial time, was degraded to a mechanical contrivance. A severe shock was from that moment given to our appreciation of its beauty. But such has since been the fate of many beautiful things that once lived entirely in the imagination. Science takes us behind the scenes, which the poet and artist only sit in front of and admire. The enquiring spirit is not content passively to look on, but must investigate the stage machinery. And when we find that we can turn the knowledge we thus gain to a beneficial use, such enquiry becomes a duty and a passion. We are fated to know the causes and processes of things, as well as to enjoy their effect upon our sensibilities. But there is no good reason why knowledge should war with sentiment, if the true function of each is borne in mind and kept in its proper place.

The chief reason why scientific knowledge conflicts with sentiment, and curtails imagination, is that it induces a scientific habit of thought instead of a passive yielding to the enjoyment of beauty and the pleasant reveries it would inspire. Our scientific curiosity is excited, and we find ourselves trying to explain the physical causes of the effect of the impression produced on us. We are like the geologist who was insensible to the beauty of the Apollo Belvedere, because he was examining the texture of the marble. We cannot enjoy to the full the beauty of the rose for thinking of its cellular tissue, and the tender hues of

sunset lose their poetic spell because they remind us of the refraction of light. And yet, as we have said, the scientific and the poetical views of Nature ought not, in a well-regulated mind, to war with each other. They are opposite attitudes of the mind, it is true; but they are complementary, and should correct and support each other. Science eradicates superstition. Art teaches us to enjoy Nature without analysis, and Science to investigate her. The artistic interpretation of Nature is one-sided and passive; it is the impression which Nature makes on our sensibility. But the scientific interpretation is active, and engages our reason. Together they employ all our faculties, and we feel not only the sensuous pleasure inspired by the illusions of her beauty, but the rational satisfaction of knowing causes. Nature is no longer to us merely what she seems; we have learned to know, in part at least, what she is. This knowledge must, of course, to a certain extent prune our imagination of some of its false conceptions regarding her; but clearing away what is false cannot be permanently baneful; it ought rather to be, in the end, a benefit. Moreover, for the cherished fancies which she sweeps away, Science often bestows ideas of Nature far more marvellous and grand.

We ought not, however, to be slaves to the scientific view. When we are undergoing a course of purely scientific study it will of course be paramount. But a true education will counteract its influence by the study of art and letters. Scientific knowledge should be worn "lightly like a flower," and in harmony with all other learning. If, owing to our imperfect knowledge and training, Science should overshadow our lives like the baleful Upas tree, let us reflect that it is only because our Science is fragmentary, our training incomplete. For we may rest assured that there is no discord intended between man and Nature. The great and good Michael Faraday, with all his knowledge and scientific habits and thought, could still feel the true poetic ecstasy of the sunset and the lightning flash. Perhaps the profound insight he had into the divine energy at work in both of these spectacles, only heightened the sublime feeling with which he gazed upon the calm beauty of the one and the terrific splendour of the other.

We know that beauty is an illusion of Nature on the senses. We know from Science that sunlight and colour, music and sweetness, have no existence outside of our senses. That which causes the sensation of light is a wave-motion in the luminiferous ether, and sound is due to a wave-motion in the air. But yet colour and sound and sweetness

are as real subjectively as matter in motion is objectively. The universe may be silent and dark where there is no mind and sense; but it springs into light and music wherever there is an eye and an ear. The harmonic motions are there, but there needs a new creation to give them meaning, and change them from a dark mechanism into a vision of beauty,—an intelligent being to whom the dismal soulless engine is a minister. The sense of beauty is a divine gift for man to have pleasure in his dwelling-place, and to all but certain exceptional minds it is the most pleasing mode of regarding Nature. It is too precious to lose, and should be carefully cultivated. The old Greek worship of beauty is now impossible, but yet it should receive a due portion of our reverence. Science itself would counsel this, for true beauty means perfect health. The love of literature and art is to be fostered, for these foster the love of beauty and the imaginative and emotional parts of our nature. History and poetry, pictures and the drama, raise us out of the grooves of actual experience and widen the contracted knowledge of life we have gathered from it: they breathe into us broader, loftier, and therefore truer notions of life; for our petty experience would be an inadequate measure of the world. They inspire a reverence for our fellow men and for every living thing. So, too, does Science when we are not immersed in its details, and are free to contemplate its grander revelations. The study of literature and art, communion with Nature, and intercourse with our fellow men, help to raise us to that unbiassed position. Science has no longer a morbid hold on us. We are dragged from the shade of the Upas tree, and can survey it with impunity, finding in it a medicine instead of a poison. Without destroying the reverence, Science, when properly studied, only confirms the truth of the ancient saying, "*We are fearfully and wonderfully made.*" By the comparative study of the lower creatures we may get a higher appreciation of the wonders of our own nature, and still exclaim with Hamlet "What a piece of work is man!"

Not only does beauty link the soul to Nature, but it leads it to something beyond. It induces strange spiritual aspirations. A beautiful sunset evokes ineffable feelings in the soul, infinite longings, and strange dreams of "perilous seas and faery lands forlorn." Can Science chill these feelings by saying that we are tricked by the mere prismatic refraction of solar light in passing through atmospheric vapour—a mechanical illusion of the senses? What then becomes of our mysterious indefinable feeling of the infinite? We

may answer that it is as real as the vapour and the solar light, and produced as naturally by the colours of sunset as refraction is by vapour. We may ask if we are not surrounded by that same Infinite which the sunset woos us to reflect upon. But the Infinite, and the why and wherefore we are here, are matters for the soul, and not altogether for chemistry or physics to consider.

A judicious blending of all kinds of culture, then, is what we require, each correcting the extravagances of the other. We should view Nature like an artist, seeing in her the Divine art; we should feel Nature like a poet, seeing in her the Divine spirit; we should know Nature like the man of Science, seeing in her the Divine mode of working; we should seek harmoniously after beauty, goodness, and truth.

What, after all, is the scientific view of Nature? The most we can know is that we can know nothing. Notwithstanding all the advance of positive science, the dictum of Socrates is still profoundly true. We learn a great deal about the actions of certain small bodies believed to exist, called molecules, the stones of the temple of creation. We know many of their groupings and interchanges. We can figure them symbolically as an algebraist writes formulæ. But they themselves are essentially unknown quantities still. We may measure them by the intellect, but we can never see them. They have what we call certain properties, but what they really are is beyond our ken. They must ever remain mere ideas to us. So, after all our Science, we come to mystery in the end. Our reallty lands us in ideality. All our Science can only stem back the unknown ocean of truth, mystic and awful, from the organism to the ultimate atom. We can only regard the universe, and man the microcosm, as a whole, whose wondrous construction we may gain some wise insight into, but whose material is an unfathomable mystery.

> "We are such stuff as dreams are made of,
> And our little life is rounded with a sleep."

IV. ECONOMIC ENTOMOLOGY.*

NO Science is so generally slighted, ignored, and misunderstood as is Entomology. Hysterical humanitarians, novelists, poets, political agitators, classical students, speak in terms of contempt or horror of the "fly-hunter." Pope exclaims sneeringly—

> "O! could the sons of men once think their eyes
> And reason given them but to study flies."

Mr. Ruskin, in his "Fors Clavigera" (Letter 53, pp. 138, 139), writes, certainly not in a lucid moment,—"The instinct for the study of the lower forms of undeveloped creatures is the precise counterpart of the forms of idolatry (expressed in the worship of unclean beasts) which were in great part the cause of final corruption in ancient mythology and morals." Ebenezer Elliott satirises the working-class naturalist who busies himself with examining butterflies and beetles rather than with the speeches and writings of demagogues. At a recent Exhibition a noble lord, pausing before a case of Lepidoptera, expressed a regret that Entomology could not be pursued in a more humane manner.

Such being the state of general ignorance concerning insects and their study, it is time that the eyes of the public should be opened as to the importance of the subject. Strange as it may sound, animals are capable of affecting man's interest and destiny for good or evil, almost inversely as their size. We nowhere find that the presence or absence of any large or individually formidable beast has occasioned famine and pestilence in any region of the globe. But who does not know that both these scourges have been again and again brought on by an inroad of locusts? On the other hand, it is equally clear, though less widely known, that the absence of certain species of insects may render the introduction of valuable crops impossible, or at least unremunerative, in countries where the soil and climate are in every respect suitable. Without humble-bees we cannot have, *e.g.*, clover, or scarlet-runners.

But in cases where insect depredators do not bring on absolute famine, they commonly levy a severe tax upon the

* Manual of Injurious Insects, and Methods of Prevention. By ELEANOR A. ORMEROD. London: W. Swan Sonnenschein and Allen.

produce of the farmer and the gardener, and consequently, *pro tanto*, they impoverish the community at large. The losses occasioned by the *Phylloxera* in France and the adjacent countries, by the Rocky Mountain locust and the potato-beetle in the United States, are matters of general notoriety. So thoroughly have the people of America been impressed with the magnitude of the damage inflicted by these and other vermin, that several of the States have appointed official entomologists whose duty it is to examine into the habits and the life-history of every insect found to be noxious, with a view of devising ways and means for its destruction. In this manner such an amount of benefit has been already effected that our thoroughly practical kinsmen across the Atlantic recognise the outlay thus incurred as a good investment. More than this; they see that a knowledge of Entomology is exceedingly valuable to the farmer and the planter. We in England have not taken any similar steps. If the nation, or any portion thereof, needs chemical, physical, botanical, or zoological advice, we are accustomed to expect that men of Science will not merely give their time and labour gratuitously, but even undertake costly experiments and observations without the prospect of remuneration. We have hitherto not fared badly on this system, unreasonable as it must be pronounced. Nor do we recommend the appointment of, *e.g.*, county-entomologists in England. Were such offices created we fear they would be filled by men who have passed brilliant examinations in all manner of subjects, especially in such as are glaringly irrelevant, but who are utterly useless in research, and whose crammed minds are void of suggestiveness. The writer of the book before us is worth a score of examinees.

It must be at once admitted that insect plagues are less rife here than in America, or, indeed, than in most parts of the great continents. Our chilly summers, our cloudy skies, and the general uncertainty of our climate, are not, upon the whole, favourable to the development of insect-life. We are poorer both in species and individuals than are most countries situate between the same parallels of latitude, or enjoying the same average temperature. Nevertheless the injuries which our crops sustain from "creeping things" are far from trifling, and deserve especial attention now the farming interest has suffered so much from a succession of ungenial seasons.* Perhaps in the long run the extirpation

* Those who consider that our climate has undergone latterly a change for the worse are reminded that Shakspeare ("Midsummer Night's Dream,"

of noxious insects would relieve our agriculturists more than any of the political movements so generally prescribed in modern England as drastic remedies for all the ills a community is heir to.

Let us consider: there are, we may assume, in England and Wales, 24 million acres of land in cultivation or laid out in pasture and woodlands. What is the average loss per acre resulting from the attacks of insects? If we look at the hop-gardens of Kent, Surrey, Worcestershire, &c., we sometimes find the crop reduced by one-half, two-thirds, or even totally destroyed, from the ravages of Aphides, the so-called red-spider (which, though not strictly an insect, may rank as such from an economical point of view), the hop-bug, and the hop-flea. In orchards and market-gardens it is nothing uncommon to find some particular crop,—fruit or vegetable,—otherwise promising, fail from the assaults of caterpillars, the American blight, scale-insects, weevils, &c. Apples, plums, and cherries are often thus swept away. The number of cauliflowers, cabbages, and their congeners riddled by the larvæ of the "cabbage whites" and the cabbage-fly, so as to be utterly unfit for human consumption, is often most alarming. As for the ordinary root and cereal crops of the farmer, they, too, suffer heavily. But let us look rather at pasture-lands, apparently the least liable to damage from insects. We shall often notice the grass and clover turning brownish yellow, and dying off in patches, as if it had been liberally drenched with boiling water or sprinkled with brine. This mischief—which is most common in moist, somewhat marshy districts, on heavy clay soils, and in reclaimed bog-lands—is due to those most un-

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Act II., Scene 2) describes a season identical in its features with "cruel '79":—

> "Therefore the winds piping to us in vain,
> As in revenge, have sucked up from the sea
> Contagious fogs, which, falling in the land,
> Have every pelting river made so proud
> That they have overborne their continents.
> The ox hath therefore stretched his yoke in vain,
> The ploughman lost his sweat, and the green corn
> Hath rotted ere its youth attained a beard.
> The fold stands empty in the drowned field,
> And crows are fatted with the murrain flock.
> And thorough this distemperature we see
> The seasons alter, hoary-headed frosts
> Fall in the fresh lap of the crimson rose."

Let these lines prove that bad seasons were well known in the Elizabethan Age.

comely creatures the crane-flies, or daddy longlegs (*Tipula oleracea*, *T. maculosa*, and *T. paludosa*). When in the larva or grub state these creatures feed in a most destructive manner, cutting off the stems of grass, corn, &c., just beneath the surface of the soil, so that the plant withers. According to Miss Ormerod they destroyed in 1880 hundreds of acres of winter-wheat in the neighbourhood of York. But grass has also other enemies. The wireworms, or larvæ of the various kinds of *Agriotes*, include it among the crops to which they pay special attention. In addition the larvæ of other Elateridæ, similar in their structure and habits, such as *Ctenicera pectinicornis* and *cuprea*, are a great nuisance in the grass-lands of Wales and the North of England. In short, whoever carefully notes the variety and the numbers of plant-destroying insects, and takes account of their ravages from season to season, will not think five shillings per acre an excessive estimate of the loss thus yearly occasioned. Here, therefore, we have a tax of about six millions sterling levied in the first place upon the farmers and gardeners of England and Wales, and of course through them affecting the whole community. It need scarcely be necessary to expound at length that the more cockchafers, daddy longlegs, wireworms, and the like the farmer has to feed, the lower wages he can afford to pay his labourers, the smaller must be his profits and his consumption of manufactured goods. That in many seasons our estimate might be doubled, or even quadrupled, without exceeding the truth is but too probable. Every agriculturist knows well the meaning of finding himself compelled to re-sow a field where the first crop has been eaten up.

Miss Ormerod has made these insects her especial study, and in the work before us she gives a clear, practical description of their appearance, their habits, the circumstances that favour their increase, and the most feasible means for their destruction. In many cases, it must be duly noted, the best remedy consists in restoring the balance of Nature, with which we, like most other nations, have ignorantly tampered. The great patrons and promoters of insect pests are boys who destroy birds'-nests, the bird-catchers who swarm out from our large cities on Sundays and public holidays, gamekeepers, and, perhaps more than all, those crowds of roughs who—without regard to "close times" and to the rights of property—shoot down every winged creature whensoever and wheresoever found. The true sportsman, if he would only instruct his keepers to be less indiscriminate in slaughtering insectivorous birds,—*e.g.*,

the so-called goatsucker,—would have by no means an unfavourable influence. We must even declare our opinion that the preservation of winged game, especially partridges and pheasants, is from this point of view a boon to the farmer, and any change in the law which would render such preservation impossible would tend to the increase of noxious insects. The pheasant is a most diligent destroyer of wireworms. The partridge, as well as the rook, feeds eagerly upon the caterpillars of the turnip-moth and other destructive larvæ. Hence the eradication of game might prove a very serious mistake.

The late Edward Newman frequently cautioned the public that if we increase the quantity of any special crop so as to attract some special insect, and at the same time destroy the birds which feed on such insect, we must expect to suffer. Miss Ormerod repeatedly calls attention to the services of the ladybirds (Coccinellidæ) in freeing the hop and other plants from Aphides. It is unfortunate that many people are ignorant enough to confound the ladybird with the bedbug, and destroy it accordingly, We do not see mention made in this connection of the *Telephori* (soldier- and sailor-beetles). These creatures are more active and voracious than the ladybirds, and generally more numerous, so that their utility as destroyers of plant-lice is proportionally greater.

From the study of this book, and indeed from that of Economic Entomology in general, certain very important biological lessons may be learnt. Among the prominent tenets of the Old Natural History it was formally laid down that the diet of every animal species was constant, the structure of the stomach and intestines, and even the chemical character of the gastric juice and the bile, &c., being specially arranged accordingly. This was theory, or rather assumption. Careful observation teaches us something very different. We find that a species, as it spreads into new habitations, sometimes alters its diet, and thus suddenly becomes a scourge to the farmer. We see, also, that animals even when not pressed by hunger—and much more when this is the case—will consume nourishment quite at variance with our traditional opinions. The catalogue of living beings which are either purely carnivorous or purely herbivorous is not nearly so extensive as it was formerly supposed.

Another point which has come of late into very distinct prominence is that the organisation of an animal, and the general character of the group to which it belongs, are no

sure clues to its habits. Of this we have an excellent illustration in Miss Ormerod's work. We find here the figures and description of *Silpha opaca*, a beetle which in France, Ireland, and elsewhere has been observed to occasion much damage to mangolds, beets, &c., sometimes ruining entire crops by devouring the leaves as they appear above the ground. Yet this creature, which thus proves itself abundantly herbivorous, if not an absolute vegetarian, belongs to a group of carrion-feeders which may be called insect representatives of the vulture or the hyæna. One of its near kindred, further, *Silpha quadripunctata*, feeds almost exclusively upon living prey in the shape of caterpillars, &c. It is therefore instructive to find, in such a family, one member at least which is able to subsist upon the leaves of plants.

Again, the Geodephaga are well known to be a distinctly carnivorous group of beetles, specially organised for capturing and devouring other insects. Yet, in the course of their researches, American entomologists have distinctly proved that several members of this group are clearly, if not exclusively, plant-eaters. *Zabrus gibbus*, a British insect belonging to the same tribe, appears to devour the ears of corn. We have observed more than one species of *Carabus* proper feeding upon fruit, and even coming to the patches of sugar smeared upon tree-trunks to attract moths—a repast of which even spiders will partake.

Another consideration suggested by this work is that few insects—indeed few animal species of any rank—are unmixed benefactors to man. An insect may serve us by aiding in the fertilisation of the blossoms of our food-plants, or by making war upon noxious species, but may yet, at the same time, be itself guilty of more or less mischief. Thus we find here reference to the fact that the humble bees—without which some most important crops would be doomed to sterility—occasionally render the blossoms of the bean abortive by perforating the calyx so as to get at the honey within. The authoress, however, very justifiably doubts whether the damage occasioned is ever serious.

Another case of the kind is that of the common wasp. Its depredations on the choicer kinds of fruits bring down upon it the hostility of the gardener; and in many parts of the kingdom its numbers have been much thinned by the destruction of the queens in spring, when they are seeking a site for their future nests. But, on the other hand, the wasp serves mankind by capturing and devouring many blowflies, and other Diptera, which one moment may settle upon

carrion and the next upon our food or our persons, and may thus convey to us some deadly virus. In all such cases the good and the evil should be carefully weighed, and no attempts at general and systematic destruction should be made till the evil has been found to preponderate.

There is another lesson to be learnt from this book, of especial moment in these hysterical times, though not needed in former days. Nature gives us merely the option of destroying or being destroyed. A general renunciation of animal food, as recommended by the Vegetarians, and it seems by the "Occultists," would not exempt us from the necessity of constantly taking animal life. The farmer and the gardener kill, and must kill, a far greater number of creatures than does the butcher, the sportsman, or the fisherman. It is true that when insects, snails, and others of the lower animals are crushed, we do not see a red liquor emitted, and we may therefore flatter ourselves with the notion that we are not shedding blood,—a plea that reminds us of the Holy Inquisition, who, when sentencing a man to the stake, declared—"*Ut quam clementissime et citra sanguinis effusionem puniretur.*" But if man is not justified in putting to death sheep and oxen for food, neither is he at liberty to kill wireworms, cockchaffers, and the like, for the same ultimate end.

Miss Ormerod's work must be pronounced a most valuable contribution to the literature of scientific husbandry, and will, we hope, convince men of the world of the practical importance of entomological science.

V. ON THE POISON OF SERPENTS.

A FEW months ago ("Journal of Science," 1881, p. 734) we gave a summary of the researches of Prof. Selmi and Dr. Gautier on a newly-discovered class of animal poisons. These compounds, the so-called ptomaines, were found to agree in all their essential properties with the venom of serpents. Both appeared to be definite chemical "individuals," capable of crystallisation, retaining their fatal properties after boiling, acidulation, repeated filtrations, desiccation, and even heating up to 257° F. for

several hours. On the other hand, by a sufficient degree of dilution or by a reduction of the dose, they might be rendered harmless. On the faith of these observations Dr. Gautier argued—and as it seems to us quite legitimately—that snake-poison could not be a virus or figured ferment, owing its deadly efficacy to the presence of microbia, or organic germs, as is the case with the *materies morbi* of splenic fever, &c. We pointed out then that the eminent Brazilian physician Dr. de Lacerda had come to very different conclusions. The views of the latter *savant* appear to have been endorsed by one of the chief representatives of French official Science—M. de Quatrefages—in a memoir presented to the Academy of Sciences. This paper we shall beg to lay before our readers, premising that, whilst Dr. de Lacerda has experimented chiefly with the venom of *Bothrops jacaranda*, Dr. Gautier has examined that of a closely-allied species, the redoubtable lance-headed serpent of Martinique, which some zoologists place in the genus *Bothrops*.

M. de Quatrefages commences by referring to some of the cures effected by Dr. de Lacerda by the subcutaneous injection of a dilute solution of potassium permanganate. He says—"Among the cases recorded there are some exceedingly remarkable, where the injections have not taken place until eleven and twelve hours after the bite. Extreme swelling of the limbs, profound anxiety, and hæmorrhage, inward or outward, all announced the approach of death. Yet after some injections all these symptoms have disappeared, and the wounded persons have been completely restored in a few days. These facts, collected in different parts of the Brazilian territory, and accompanied with minute details, seem to be beyond all doubt. They confirm the experiments made by Dr. de Lacerda in presence of the most competent judges, and with the assistance of one of our countrymen, Dr. Couty, a pupil of Claude Bernard.

"To comprehend all the importance of the discovery due to Dr. de Lacerda, we must remember that in those countries a certain number of persons succumb every year to the bites of various species of serpents. In Martinique alone, with a population of 125,000, the annual mortality from the bite of the lance-headed snake is fifty, not counting those who remain lame or infirm for the rest of their days. We see, therefore, what a service the eminent sub-director of the Physiological Laboratory of Rio Janeiro has rendered. France itself may profit by this beautiful discovery. Without doubt, of all our serpents, the viper alone is venomous, and its bite is far from being as formidable as that of its

tropical congeners. Yet the viper does more damage than is commonly supposed. The question has been repeatedly laid before the Society of Acclimatisation. In 1859 a commission was nominated to examine into the matter; an inquiry was instituted, and in 1863 a report was drawn up by M. Soubeiran. From the evidence collected during these four years it results that if some departments do not seem to produce vipers (Nord, Haute-Saône, &c.), and if in others they are rare (Meuse, Vosges, Bouches de Rhône, Oise, Corrèze), there are others where these reptiles swarm to such an extent as to constitute a real danger for the inhabitants of the country (Vendée, Loire-Inférieure, Haute Marne, Lot, Côte d'Or). Here rewards have at intervals been offered for the destruction of vipers. These measures have generally produced good results. In Haute Marne, in the year 1856, the number of these reptiles brought in to the local authorities was 17,415. In six years the destruction of 57,045 venomous serpents was officially certified.

"Unfortunately the enquiry led to no precise information as to the number and the nature of the accidents caused by the bite of vipers. It appears merely that our large domestic animals recover very rapidly, and without requiring any treatment, whilst sheep and goats frequently perish if they do not receive prompt assistance. It is often the same with dogs, especially if bitten in the nose. But even after a cure they often remain all their life long extremely weak, and suffer from defects of sight and hearing, which render them unfit for hunting.

"It has long been known that an adult man, if bitten by a viper, may recover spontaneously. But we know also that in this case the phenomena, both local and general, are more pronounced, and very often lead to a fatal termination. In any case they are ordinarily grave and painful. There is room to hope that the means of cure discovered by Dr. de Lacerda will enable the symptoms to be arrested promptly and with certainty. The process succeeds as well with animals as with men.

"In describing his process Dr. de Lacerda insists on the necessity of preparing the solution of permanganate at the moment when it is to be used. He makes up beforehand small packets of the salt, each containing 0·1 grm. (about 1½ grains), and a flask containing 10 grms. of water. He obtains thus, at the required moment, a solution of the exact strength needful. The injection is made by means of a Pravaz syringe. A ligature should be placed above the bite, and half a syringeful of the liquid should be injected

into each wound made by the teeth of the reptile, and the tissues are then compressed to favour the diffusion of the liquid. If the limb is already swollen several injections should be made about the boundaries of the swelling. If the rapidity of the symptoms seems to indicate that the venom has been introduced directly into a vein, an injection should be made into a superficial vein.

"I may be permitted here to add a brief reflection: from researches anterior to those of Dr. de Lacerda it results that the venom of serpents owes its toxic properties not to the liquid itself which is secreted in the glands, but to corpuscules more or less analogous to those discovered daily in virus. Is there here a hint to be taken? Would potassium permanganate, so powerful against the venom of the *Bothrops*, do similar service if employed against some of the diseases the cause of which has been discovered by M. Pasteur?"

This memoir suggests a few remarks. We note, in the first place, that the learned Academician accepts already as a demonstrated fact the efficacy of potassium permanganate for the bites of serpents. Now, unless our memory greatly deceives us, it has been tried repeatedly, and in vain, for the bite of the cobra in India. We are, however, quite willing to admit that the poison of the cobra and that of the *Bothrops* may differ quantitatively, and even qualitatively, that of the former being beyond doubt the more malignant.

Still it appears somewhat rash to pronounce Dr. de Lacerda's method of cure successful just when its value has been referred to a Select Committee of the Academy for close examination. Pending the conclusion of such inquiry suspension of judgment would, we submit, be the proper course.

As regards the number of vipers in France, we fear that there has been an increase during the last twenty years. This has been especially the case in the Gironde, where their only efficient enemy, the hedgehog, has been much persecuted by gamekeepers. As regards the danger of the bite to man, we believe that it is much under-rated in zoological text-books. From evidence which has reached us, and from our own observations, we should think that about one case in five proves fatal, the danger increasing with the heat of the climate and of the season, and with the fatigue or the constitutional weakness of the subject. Many of our readers will recollect that a few years ago a young man died from the bite of a viper received on Leith Hill,

It must be remembered that these reptiles are increasing in England as well as in France, and from the same cause—the extirpation of the hedgehog. We have repeatedly seen them in Epping Forest, and in some of the Hertfordshire woods they are numerous. No one seems to have observed whether in England and France they show a marked preference for any particular kind of vegetation, as in Eastern Europe they do for the marsh-rosemary (*Ledum palustre*).

At the close of his memoir M. de Quatrefages formally accepts the ferment-theory of serpent-poisons as if already established by "anterior researches." In so doing he completely ignores the investigations of his own eminent countryman Dr. Gautier, as well as those of Dr. Winter Blyth.

There is another point which we cannot overlook; the remedy for snake-bites, if such a one exists, can only be found out by experiments upon animals, which in the hysterical cant of the day are denounced as "violationism," "diabolism," &c. We would therefore ask whether, seeing that in India alone some 50,000 persons perish yearly from snake-bite, such experiments are not the imperative duty of those who have the opportunity and the skill to perform them? If any person, whether prelate or homœopathist, whether judge or doctress, can suggest another method, the scientific and medical public are prepared to hear. Dr. de Lacerda has reached his conclusions solely by means of experiments performed upon animals!

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 156.)

THE workshop in the school, the school in the workshop, and other forms of what are termed Apprenticeship Schools, have all been tried, and exist at the present time in France; and in some form or another they have been established in most Continental countries; but France is the country in which they have been most developed.

It has been proposed that schools of a similar kind should be established in the United Kingdom; and it is chiefly with the object of enquiring into, and reporting on, the success of this class of Technical Institutions on the Continent that the Royal Commission on Technical Education has been appointed.

The aim and object of these Continental schools is to train those intended to be artizans, not only in ordinary hand work, but in handicrafts that are more or less undeveloped in the respective countries; and especially to train them to equal our own craftsmen in those industries in which we have hitherto had the supremacy. The reason adduced for the necessity of establishing such schools in this country is owing to the change that has taken place in recent times in the apprenticeship system. The master of the present day, it is urged, unlike the master in olden times, is not acquainted with his craft; he, as a rule, is simply an employer of labour, a capitalist, and not a craftsman; hence he is incompetent to teach—as was formerly done by the masters—the apprentice his trade. The apprentice of even average intellect now acquires in consequence a very imperfect knowledge and skill, it is stated, of his trade, as he is left to learn it from those—the foremen and the other workmen—who have no interest, pecuniary or otherwise, in teaching him.

The Commissioners will, it is to be hoped, not only give the nation the benefit of their opinion as to how far these Apprenticeship Schools have fulfilled the purpose for which they were established in foreign countries, but what is much more important for the nation to know, how far, and in what way, they think they would be likely to benefit, not any particular craft, but all our various manufacturing industries, by giving those intended to be artizans a suitable education previous to their being apprenticed to any trade, and what kind of administrative and other machinery ought to be employed for properly carrying out such a system of technical education.

It may not be inappropriate or undesirable to consider, even before the Commissioners make their report, whether such a system of technical education is the one best fitted to render our artizan classes more efficient craftsmen. And in considering the subject, the education America is providing for its artizan class ought not to be overlooked; for we have more to fear, I believe, in the future from the industrial productions of that country in our own and other markets than from the productions of Continental nations. The raw materials we have, which have very greatly assisted in making

us the leading manufacturing country in the world, exist in greater abundance in that country than in our own; and America possesses in addition at least one raw material, cotton, which we do not possess, and on which one of our great staple industries is based, and they are beginning to try and supersede us in cotton goods on the continent of Asia, which at the present time is our best neutral market for that class of manufactures. The singular talent their mechanists have displayed in the invention of labour-saving machines and other mechanical inventions is well-known: the cheap labour of Switzerland is no longer able to compete with their automatic machinery in the manufacture of cheap watches and clocks, and horological apprenticeship schools will never be able to train workmen to compete with their machinery in this branch of manufactures. And yet they have, I believe, no apprenticeship schools, but rely on the good public education they afford every class of their citizens, to fit each class for their future pursuit in life. And their brain-workers and hand-workers certainly appear much more capable than those classes do in the older civilised countries of engaging in a greater variety of employments, from the greater flexibility, if I may so term it, they display of mind and hand. This greater universality was well illustrated at the close of their war, each officer and soldier when disbanded entering upon some civil employment. This greater adaptability may be due in a measure to the fact that America is as yet a comparatively new country, and therefore the avenues to employment are not so over-crowded as in older countries.

In all schools where the training of the hand as well as the mind is undertaken, the exercises employed for hand training should be of such a nature that the manipulator would acquire the greatest dexterity of hand in performing them. But not only should these *manual exercises* impart manual dexterity, but they should likewise be of such a character that the eye would be systematically and artistically educated. The Apprenticeship Schools, on account of the nature of the manual exercises given to the students, do not evoke this scientific manual skill, and the French, who have tried these schools to the fullest extent, are beginning to perceive it. They say "that the art industry of France is being lowered, and that the young idea must be more ably taught and tutored in the way it should go. At recent exhibitions it was shown," they state, "that England was on a level with France in the furniture and china departments; that Austria was on a level with France by reason of her

bronzes; that Italy was on a level with France by reason of her glass ware; that Japan is becoming a dangerous competitor; and that Belgium and America are making giant strides; and therefore France must make up her mind to give her workmen *a complete artistic education, and better opportunities of widening their intelligence and increasing their knowledge.*" And when M. Ferry was recently presiding over the French Commission on Art Industries he dwelt on the necessity of "Awaking in the artizan the slumbering artist, not to disgust him with his calling, but to elevate it, and make it both more profitable and more attractive. Drawing must be obligatory," he said, "in every stage of education, and the effects of machinery and the excessive sub-division of labour must be counteracted. Individual initiative must be encouraged, *and anything like official teaching in cabinet-making, pottery, &c., must be avoided.*"

The experience the French have gained with regard to the defects of these Apprenticeship Schools should not be neglected by those who have the direction and management of our educational departments. Let us cease piling one educational institution upon another, but let us simplify and render more efficient our educational machinery, and reform and reconstruct, if necessary, our existing institutions.

Our workshops and manufactories are, I believe, the best technical school our artizans could have for learning and acquiring skill in their trade; but they, like those who are intended for directors of industries, require a school education that will best prepare them, both mentally and manually, for their future avocations. It should embrace, in addition to the three R's, the elements of mathematics and the principles of mechanics; drawing should be carefully and systematically taught in its various branches, not by means of copy, but from objects; and something likewise of the sculptor's art ought to be taught. Hand and eye would thus be efficiently trained as well as the mind. Such an education would greatly excel the teaching of cabinet-making, pottery, &c., in training the future artizan to be an intelligent and efficient workman. But then the teaching of these subjects *must be real and highly efficient*, so that a sound foundation is laid on which the taught can afterwards raise a suitable superstructure. Thorough instruction at school is even more necessary for the artizan than for any other class; for if he has been imperfectly taught it is too much to expect that he will devote a portion of his few leisure hours in relearning and continuing his studies. For the difficulties that beset the artizan in pursuing serious studies during his leisure

hours are very formidable even under the most favourable circumstances, for the *energy* each person possesses is limited, and much of the artizan's energy has to be expended on his daily manual labour; consequently, if he has to contend, along with exhausted energy, with imperfect training at school, it becomes well-nigh hopeless. I have directed attention to this subject in my work on Scientific and Technical Education, as it is not only important, but one so frequently unthought of, or overlooked, by those who have the framing of educational schemes for instructing the industrial classes in their leisure time.

Professor Goldwin Smith, in his address to the Social Science Association last year, alluded to this subject in connection with the Cornell University, of which he is one of the Professors. In this University manual and mental labour are combined:—"The University," he stated, "had succeeded in a general way. *But the special plan suggested to the mind of its benevolent founder by his own history, of enabling poor students to maintain themselves by manual labour while they received a University education, must be said to have failed.* Mental and manual labour draw on the same fund of nervous energy, which will rarely suffice for both, and in ordinary cases excellence can only be attained by undivided attention to study."

Although to many workmen the further progress in mental studies which require much concentration of thought will, after they leave school, be impossible on account of the great exhaustion of their energies on their daily labour, yet there ought to be evening schools or colleges accessible to workmen, so that those of them who are more fortunately situated as regards the nature of their employments, might thus have opportunities afforded them of pursuing their studies. The character of these colleges or schools as regards the subjects to be taught, the management of them, &c., will be considered further on. Along with the school or college there ought to be accessible to the artizan Libraries, Art and Technical Museums, and the means of securing Patents for inventions ought, by a reform of our Patent Laws, to be within the reach of inventors in humble circumstances.

Good public libraries now exist in almost every English town of any importance, but Art and Technical Museums have not been supplied or aided by the State in the way they ought to have been in the Provincial towns, and if these accessories to technical and artistic teaching are wanting, much cannot be expected to accrue from merely a good preliminary education. Much valuable evidence on this and

kindred subjects was given before a Select Committee of the House of Commons on Schools of Art, in 1864, by the then largest calico printer in the world, Mr. Edmund Potter. "I attribute," he stated, "the original superiority of French designs for calico-prints, altogether to the atmosphere of taste which an artist lives in in France. I remember sending over two young men to Paris to design for my own house; we had them there for some time, and while they were there their designs were equal to the French, *but when they came back to us there was not the same artistic atmosphere surrounding them, and their designs went back again.* It is not likely, as was suggested just now, that a man would have the same taste in the back streets of Manchester that he would have in Paris, *with the chances of refreshing his sight with everything fresh and beautiful.* I take it that Paris is the best market in the world for the designs of our class, at least it has so proved."

Mr. Potter stated that he believed the entire payment at that time by the English calico-printers for French designs alone was upwards of £50,000 a year. Notwithstanding the murky atmosphere of our manufacturing towns, if an atmosphere of art were created by the establishment of Art Museums, we might expect to return to the more fortunate position we were in previous to 1840. At that period there was considerable employment for English designers. Most of the calico-printers kept up large establishments, and there were many men receiving from £100 to £500 a year as designers for the trade; and in a large school in London that existed at that time, there were individuals connected with the school who realised as much as £1000 a year by designing patterns. But when the Manchester people asked for a small portion of the grant voted yearly by the State for art education, they were informed their lordships could not grant it, as State aid would sap the self-reliance of the provinces; they must therefore depend upon themselves; and this opinion has been practically adhered to up to the present time. The Commissioners for the Exhibition of 1851, answered the deputation of provincial municipal representatives who waited upon them at Marlborough House in July, 1877, in pretty much the same terms, when the deputation asked them to give the provinces a part of the money they still had at their command for the purpose of fostering art and its applications. But self-reliance, self-dependence are never raised up as obstacles to the granting of State money for Art Museums, Art Collections, &c., in the wealthiest City in the world; and these grants go on

increasing year by year, and the wealthiest part of the Capital of England receives the lion's share of them.

The establishment of Art Museums in London cannot create an art atmosphere in the provinces; just as a school established in London could not teach those who live in the country; and it is in Art Museums that the artistic artizan, as well as the technical artist, must perfect his taste and seek for inspiration, as the landscape painter seeks for inspiration by living a portion of his life amid the most beautiful scenery. Mr. Potter's answer to a question on the expenditure at South Kensington is as true to-day as it was when spoken in 1864—"I think there is too large an expenditure there, and too little in the country, and that it ought to be shared *if it is desirable to promote technical art teaching at all.*"

It is to be hoped that some practical plan, which will prove beneficial to the nation at large, will result from the interview which took place, on the 8th of March, between the Lords of the Committee of Council on Education and a highly influential deputation, introduced by Mr. Jesse Collings, M.P., with respect to the establishment of local museums. The deputation was not on this occasion put off with the stereotyped official answer that the provinces must rely upon themselves, and therefore it is evident that the Government feel that, even in the interests of trade and commerce, they can no longer oppose the granting of aid towards the establishment of Museums in the provincial towns. Mere loans of art objects from the South Kensington Museum will not accomplish the object sought. There must be ever present an art atmosphere, and this can only be attained by having, as in London, permanent museums. And if the collections in these provincial museums were varied for each museum, and made interchangeable at stated periods, there would thus be provided for each locality a large art collection at a comparatively small cost; and by the exchange freshness and novelty would be imparted to each collection, and the freshness and novelty would be most fully sustained, and the practical difficulties connected with the exchange overcome, if only a portion of the collection of each museum were interchanged on each occasion.

VII. THE LESSONS OF THE LAMSON CASE.

IN referring to this celebrated trial we shall take an entirely different point of view from that of our contemporaries. The questions of the guilt of the prisoner, the degree of his demerits, and the effects which his condemnation may have upon his relatives, we must put aside as completely as our modern humanitarians in such cases do the sufferings of the victim, the distress of his friends, and the feeling of insecurity occasioned to society at large. We have merely to ask how are the interests and the duties of Science affected by this murder and the subsequent trial.

We must in the first place notice the plea raised that the alkaloid discovered in the corpse of the youth John, and which when administered to mice produced the well-known symptoms of poisoning by aconitine, *may* have been one of those newly-discovered bodies, the ptomaines. It is perfectly true that our knowledge of these bodies is still very rudimentary: we neither know the exact circumstances under which they are produced, nor the exact nature of their action when administered to warm-blooded animals. But our knowledge, as far as it goes, is decidedly against the theory that the substance isolated by the chemical experts from the body could be a ptomaine. The symptoms observed in experiments with these compounds have more closely approached those of poisoning by strychnine than by aconitine.

We must also remember that this theory does not account for the death of the youth under circumstances which strongly indicated the action of a poisonous alkaloid. But a practical lesson to be drawn here is the danger of incomplete researches, especially on such subjects. Half-knowledge may readily serve the purposes of an advocate, and enable him at least to bewilder the not too clear mind of the British juryman. But how is a more complete knowledge to be obtained? We do not see any possible way save by experiments upon animals—in other words, by what is now shrieked at as vivisection. We ought to know not merely the chemical characteristics, but the physiological action of every "ptomaine," if these bodies, like legion, are many. To this point we shall have to return below.

Another very important consideration is forced upon us by the presentment of the jury in the Lamson case, and by the outcry in the political and literary papers anent the sale of poisons. There is reason to believe that any additional

restriction imposed on such sale will be felt as a serious hindrance to chemical research, and will become an annoyance in a number of arts and manufactures. The public does not know that hundreds of substances absolutely indispensable for many legitimate purposes will prove poisonous if anyone is foolish enough to swallow them. But are we on this account practically to prohibit their sale? Are the important uses of "poisons" to be checked because in some infinitesimal number of cases they may be applied to criminal purposes? Let us in the first place remember that by all our grandmotherly legislation we cannot prevent a determined criminal from getting possession of such bodies. The utmost we can effect is to make it hard or impossible to prove such possession. In this case Lamson obtained the deadly drug at a chemist's shop, and this fact, brought out in evidence, was a link in the chain of proof against him. Suppose that he had not been able to purchase it—at least without formalities which might not suit his purpose—what is he to do? Monkshood, the source of aconitine, is a common garden flower. What could hinder him from obtaining a root? The extraction of the poisonous principle in a pure form would not be beyond the skill of a man who has received a medical education. If he had been seen experimenting with herbs the circumstance would have excited no suspicion, and it might have been very hard to prove that he had had any aconitine in his possession. Quite the same with other poisons of the same group: nux vomica, deadly nightshade, the young shoots or eyes of the potato, tobacco, certain fungi, which for the present it might be indiscreet to name, the seeds of the laburnum, and many other vegetable products which may be acquired without suspicion and without anyone recording the fact, are the raw materials for these agents. The preparation is far from difficult. If, then, we really wish to render poisons inaccessible we must send out a Royal Commission to go through the realm digging up and destroying every plant, wild or cultivated, which may possibly contain poison. Our imports must be put under severe restrictions. Every bag of myrobalans—a nut used in tons by the dyers and tanners—must be carefully searched through lest, as is sometimes the case, the nuts of the strychnine plant (*Nux vomica*) may have got mixed among them.

We must also ask why should poisons be watched over and restricted more than other deadly agencies? Their possession constitutes a far smaller public danger than, *e.g.*, explosives. The number of people who have fallen victims

to poisons is an unconsidered trifle in comparison with those who perish by pistol shots, or by dynamite and the like. However criminally disposed a man may be, he can exhibit poison to those only who live with him, or with whom at least he comes in very close contact. The burglar or the garotter cannot administer a dose of aconitine or strychnine to a substantial citizen on his way home from business. Potassium cyanide will not enable demagogues to blow up ships or prisons. Further, the legitimate uses of firearms and explosives are much fewer than those of the numerous and heterogeneous bodies which are included under the name "poisons." It must also be remembered that many bodies, though deadly if introduced into the stomach, are so peculiar in their taste and smell, or in the effects they produce upon any article of food or drink with which they may be mixed, that no person is likely to swallow them. We would therefore say if the common sale of sulphuric and hydrochloric acids is to be prohibited, a thousand times more should restrictions be placed upon the traffic in revolvers, cartridges, and dynamite. Such articles should be made inaccessible to all whose purposes and past career are not absolutely free from suspicion. Next to explosives the sale of anæsthetics should be most carefully watched.

The third point we have to consider in connection with the Lamson case is of a very different kind. We were astonished to find Lord Chief Justice Coleridge quoted to show the untrustworthiness of experiments upon animals as regards the action of poisons. We must utterly refuse to acknowledge him as an authority on such a question, believing as we do that he has no personal experience in this matter, and knowing his strong anti-vivisectionist bias. It was, we believe, Lord Coleridge who sought to defend anti-vivisectionists from the charge of inconsistency by the threadbare plea that "one wrong does not justify another." Now, even admitting, which we cannot, that experiments upon animals are a "wrong," they are so rare in occurrence, and in most cases they inflict so little pain, that they sink into insignificance. We would therefore remind the Lord Chief Justice that an Authority, generally considered higher than that of the judicial bench, exhorted the fanatics of old to get rid of the beam in their own eye before dealing with the mote in that of their neighbour.

But why or when should experiments with poisons upon animals be untrustworthy? Only if such poisons affect different animals differently, and if we do not know their exact action upon the species we select for the experiment.

Now, differences in the action of poisons upon different species do occur, but they are most decidedly the exception, especially if we confine ourselves to vertebrates, to warm-blooded creatures, and still more to mammals. Many of the supposed anomalies and exceptions disappear on close examination. The poison of the cobra has proved fatal to every animal upon which it has been fairly tried. The mungus and the secretary hawk owe their success in giving battle to the death-snakes, not to any immunity from serpent poison, but to their adroitness in evading the bite. Swine are said to suffer little from the bite of the rattlesnake. But in fact the venom loses itself in the dense layer of cellular tissue loaded with fat, which underlies the skin, and rarely penetrates into a vein. We have often seen the hedgehog kill a viper, regardless of its bites. But these bites struck merely the cartilaginous mass of Hoggie's snout, and the poison doubtless failed to enter the circulation.

Dr. James Blake,* as the result of a course of experimentation extending over forty years, records the fact that the action of forty-one mineral poisons introduced into the blood was the same in all the species operated upon. Let us, however, suppose that certain poisons may, whilst others may not, produce the same symptoms in man and in some of the lower animals. We have then the two cases:—(*a.*) The symptoms in man and in, say, a rabbit or a mouse are identical. In this case there is no difficulty; the experiments will be perfectly trustworthy. (*b.*) The symptoms in man and in the rabbit are different. Here, also, there is no difficulty provided the symptoms in each case are perfectly known. Let us suppose that a man has died, apparently from a dose of aconitine, that is to say, the symptoms produced are those which aconitine is known to excite in human subjects. We extract from the contents of the stomach an alkaloid. We administer this alkaloid to a rabbit, and we find it dies with the symptoms which aconitine produces in rabbits. The results are therefore in either case trustworthy provided that the physiological effects of the poison in question are duly known. Hence the argument which the Lord Chief Justice is said to have used, instead of showing the uselessness of experimentation upon animals, proves its necessity.

* Journal of Science, vol. iii. (3rd series), p. 319.

ANALYSES OF BOOKS.

Force and Matter. Empirico-Philosophic Studies, Intelligibly Rendered. With Introduction, written for the English Edition, by Dr. LOUIS BÜCHNER, President of the Medical Association of Hessen-Darmstadt. Edited by J. F. COLLINGWOOD, F.R.S.L., F.G.S. Third English Edition. London: Trübner and Co.

THE present edition, in which the author has not found it needful to introduce any additions or emendations, may fitly serve as an opportunity for attempting an estimate of a celebrated work. Concerning Dr. Büchner's introductory letter to the Editor and the five additional prefaces, we need say the less as they are in great part replies to criticisms with which the English public is not familiar. We note that Mr. Collingwood does not "bring out this volume as one entirely in accordance with his opinions, for he cannot always subscribe to the alleged facts contained therein, nor does he agree in all the inferences drawn from these facts." We find further, at the outset, a very remarkable statement made by the author. He considers that among his own countrymen "the belief in the wonders of a supersensual speculation still appears to be stronger than the faith in reality," and hence he anticipates that his "work may not, in England, have to struggle against such gross misinterpretations as was the case in Germany." Now we generally understand that in Germany speculation in science and philosophy is freer, bolder, less fettered by conventionalism and prejudice than in our own country. Dr. Büchner, it seems, is of a different opinion.

The work before us does not bring forward either novel facts or new generalisations. Nor was such the author's intention. He seeks to deduce from the conclusions of modern Science—or from what he accepts as such—a philosophy of life for the use of the general public. As materials for his task he admits the generally received doctrines of the indestructibility of matter, the conservation of energy, and the immutability and universality of the "laws of Nature"—a term we do not like. He recognises uniformity in geology and evolution in the organic world. In common with most conscientious observers of animated nature, he holds that the distinction between the souls of mankind and of brutes is not qualitative, but quantitative. But he dissents from orthodox science, if we may be allowed the expression, in accepting so-called spontaneous generation. The teleological

interpretation of natural phenomena he rejects. A distinct vital force he is not able to admit. Innate ideas, personal continuance after death, the freedom of the will, and the idea of a personal God are also set aside. Hence it appears that the author is sufficiently "advanced" in his views, and that his work is in its character extra-scientific, if not in some of its fundamentals, yet in its results. Hence he appeals not so much to the men of research, of experiment, and observation as to those minds who crave for general conclusions, even if resting upon an insecure basis. That the author's learning is wide, and that he tells us many interesting and little-known things, must be admitted. We read—"Schubert speaks of a spontaneous origin of water in sudden accumulations of clouds; Röbbelen thinks that the animal organism produces nitrogen, and even the celebrated Ehrenberg appears yet doubtful whether the organisms create or merely transform the materials they contain"! Miracles he declares impossible, on the questionable ground that they involve a departure from or a violation of the laws of Nature. In a passage questioning the order and symmetry of the Solar System, the author, quoting Hudson Tuttle, asks—"Why did the Creator give rings to Saturn, which, surrounded by its eight moons, can have little need of them, whilst Mars is left in total darkness?" As Mars has been found to have two moons, this passage, we submit, might have been fairly modified.

The evidence which Dr. Büchner gives in support of abiogenesis seems to us singularly weak, and little in harmony with the results of recent investigations. If we do not misunderstand him, he adduces on behalf of this view the appearance of intestinal worms in special parts of animals; the origin of Infusoria, "where air, heat, and moisture combine;" the upspringing of vegetable species not previously known in the district, where a forest has been burnt down or a lake drained. "Where a saline spring gushes forth there soon appear well-marked *Calophites* and salt-water creatures, no trace of which is to be found for many miles around. Since the increase of pine-plantations in the environs of Paris there is met with the lamia (*Lamia*, or rather *Astyonomus*, *edilis*), an insect belonging to Northern Europe, which had never been seen in the above region." We have taken the insect in question in regions situate farther south than Paris, and, as it is swift and powerful on the wing, we need not feel surprised that it has taken up its abode in the pine-woods above mentioned.

The author's assumption that the entombed elephants in Siberia are proofs of a "much higher" temperature than now prevails may reasonably be challenged. Those elephants were coated with long woolly hair, and within the frozen bodies have been found portions of plants which had evidently been swallowed as food, and which are identifiable as similar to the modern vegetation of Northern Asia. That at certain epochs the temperature

of the earth must have been higher than it is at present is, however, indubitable.

The author asks, with reference to the idea of design in Nature,—"Could a being, acting from goodness and benevolence, endow the cat, the spider, and man with a nature capable of all these horrors and cruelties?" Dr. Büchner seems here to fall into the error of judging natural phenomena from a narrow and exclusively human point of view. Why should we pity the animal that is eaten more than the plant which is devoured and trodden down? That the one is conscious of feeling and the other not are assumptions far from demonstrated. To us personally it is far more revolting to see a carnation destroyed by earwigs, or a rose spoiled by Aphides, than to behold the earwig seized by a *Goerius olens* or the Aphides massacred by a lady-bird.

In a passage quoted from Count Goertz the negro is pronounced "devoid of any religious feeling." This is scarcely correct.

In the chapter on the "Brain and the Soul" we find the interesting and very just remark that "short-necked persons are lively and passionate; long-necked persons are calm and sedate."

Spiritualism meets in this work with scant courtesy. Says the author, "What the belief in sorcery, witchcraft, demoniac possession, vampirism, &c., was in former centuries, reappears now under the agreeable forms of table-moving, spirit-rapping, psychography, somnambulism, &c." Anyone reading this book, or "*Aus der neuen Hexenküche*," will see that Mrs. Kingsford's word of abuse is nothing novel, and that in hurling it at Modern Science she is merely using that vulgar flower of rhetoric "Y' are another."

The author's assertion that the common house-fly is deaf may be doubted. It has been observed that these unpleasant insects seem to recognise the peculiar buzz made by one of their number which has got ensnared in a cobweb, and at once take their departure. With Dr. Büchner's remarks on "Instinct" we heartily concur.

The question of free will is not one which can be discussed in the "Journal of Science."

"Force and Matter" possesses no small interest as characteristic of a certain school of modern thought, but in our opinion it requires very considerable revision. Certain of the conclusions reached are put forward with a confidence scarcely befitting the not unimpeachable evidence upon which they rest.

The Perfect Way, or the Finding of Christ. London: Field and Tuer, and Hamilton and Adams.

On opening the anonymous book bearing this not unassuming title we expected to find a religious treatise the examination of which we must decline as outside our competence. But we soon became convinced that the writers, if hostile to agnosticism and materialism,—we might almost venture to add "and to modern Science,"—are no less at issue with historical Christianity and with the teachings of the orthodox churches. We find here many startling assertions, to some of which we may refer in detail, and we naturally seek for their evidence. How have the writers learnt that which they set forth? Have they detected any phenomena, hitherto overlooked, from which their conclusions are legitimately induced? No; they seem to derive their doctrines from intuition. "The lectures," we are told on p. 4, "represent the results of Intuitional Memory, developed and otherwise assisted by the only mode of life compatible with sound philosophic observations." Now we will not deny the possible existence of "intuition as a faculty and a source of information," though we suspect that much of what is called intuition in man, and instinct in beasts, has a different source. But we ask, How can one man's alleged intuitions be evidence to another? How is B to know whether A's intuitions have anything but a pathological origin? How have the writers ascertained, and how can they prove, what modes of life are "compatible with sound philosophic observations"?

Among the strange opinions to be met with in this volume may be mentioned the following:—The planets are persons, possessing memory (pp. 8 and 9). Man is a fourfold being, composed of a material body, an "astral" body or "perisoul," a soul, and a spirit. Maimonides is quoted with apparent approbation for the dictum—"When thy senses affirm that which thy reason denies, reject the testimony of thy senses, and listen only to thy reason." Was therefore Maimonides the philosopher who, when told that facts were against his theories, calmly replied "So much the worse for the facts"?

On p. 15 we read—"Whether of the individual or the universal, Soul is Substance, that which sub-stands all phenomena. This substance is original protoplasm." It may here be remarked that a play upon words is a very prominent feature of this book. It should have been preferably written in the German language, which yields greater scope to such performances. We further find (p. 16) that matter and spirit are merely "two states of the same thing." Matter is "substance in its dynamic state.' The following passage, if we misunderstand it not, is put forward as an explanation of the origin of life:—"The soul's entrance into matter and primal manifestation as an individual occurs in the

lowest forms of organic life, and is due to the convergence of the magnetic poles of the constituents of some protoplasmic entity, an action due to the working of the Spirit in the Matter concerned. For all Matter, it must be remembered, has and is Spirit. The focussing of these poles gives rise to a circular magnetic current, of which the result is an electric combustion, which is the vital spark, organic life, Soul."

Again, "The process of its (the soul's) generation is gradual. The magnetic forces of innumerable elements are directed and focussed to one centre; and streams of electric power pass along all their convergent poles to that centre until they create there a fire, a kind of crystallisation of magnetic force."

As a further specimen of the physics of this book we take the following (p. 48):—"Earth is the result of the water and the air, fused and crystallised by the action of the fire." Crystallisation of force; a crystal which is a fire; water and air fused are notions so strange that comment is needless.

On p. 20 we are told that between the organic and the inorganic there is no boundary line. The doctrine of Evolution is admitted, but with the qualification that it was "anticipated thousands of years ago." In seeking to controvert those who would explain the universe by the action of energy upon matter, the authors point to "the strong set of the current of life in the direction of beauty and goodness." Alas! to the unprejudiced observer the "set" runs exactly the other way. It is not, we think, foul weeds and noxious animals that are decimated by phylloxera and anthrax; it is not the rose, the vine, or the wheat-plant that spring up everywhere and choke out less noble plants; it is not the lovely and harmless bird or insect which is able to establish itself in strange climates.

To proceed: it is asserted that the lower animals are rudimentary men, and after a sufficient number of incarnations reach humanity. "Animals appeared first on earth, not, as is vainly supposed, to minister to man's physical wants, but as an essential preliminary to humanity itself." We may here remark that Modern Science fully rejects the notion that the lower animals exist to minister to man. But on p. 47 we find it stated—"And there were none of these (*i.e.*, creeping things) in the Age of Gold, neither shall there be any when the earth is fully purged. Man's own wickedness is the creator of his evil beasts. Again, on p. 75 we find the same idea substantially repeated:—"Wherefore it is an error to hold Nature responsible for fierce and horrible creatures. The mark set upon Cain has its counterpart in the stripe of the tiger; and the Crustacea denote selfish spirits who are hard exteriorly to all the world, and soft only interiorly to themselves." Now the authors apparently understand under "evil beasts" the Carnivora (*see* p. 165), and they put forward, as a problem in teleology, only to be solved on their principles, (p. 24), the existence of beasts in the long ages prior to the

advent of man. But seeing that among those animals which flourished in the pre-human geological epochs many were carnivorous, the statement that man is the creator of such beasts is reduced to an absurdity. We might ask why the carnivorous animal alone is pronounced "evil"? It kills to eat, whilst vegetarian beasts—*e.g.*, the bull, the Cape buffalo, the black African rhinoceros, the keitloa, the peccary, &c.—will often attack man and other animals out of pure "superfluity of naughtiness." It has also been fully proved that whilst carnivorous animals in captivity become really attached to man, and show an affectionate disposition, deer, sheep, goats, &c., under the same circumstances, turn malicious as they reach maturity. This is a point of the more importance since the authors view flesh-eaters, human or brute, as the worst of offenders. In connection with this subject we must ask whether the authors, who allow of no hard and fast line between the organic and the inorganic world, would yet draw an abrupt boundary between animals and plants? If they do they are at variance with their own principles, as well as with the teachings of modern research. If they do not, then the destruction and mutilation of harmless and helpless plants must stand on the same "plane" as the slaughter of animals.

We must return to the transmigration of souls. If, as it is alleged, every animal is a rudimentary (or possibly a degenerated) man, and if every man has passed not racially, but individually, through the forms of the lower animals, it is an arithmetical necessity that the number of individuals in every species, or at least in every group, should be equal. If all earth-worms, all mosquitoes, all herrings are to become men, the number of individuals of each must not be greater than that of men. Now if we take the number of human beings in each generation at a thousand millions, each living on an average for thirty years, we must certainly reckon the mosquitoes in existence at any one time at many billions, with several generations each year. On the other hand, the total number of individuals among the Mammalia, if we except certain Rodents, is *less* than that of man. The same will be found the case with most groups of birds. This plain consideration, if fairly worked out, will we believe prove fatal to the doctrine of animals being the germs of future men. The authors, however, have judiciously abstained from sketching the ascending pedigree of humanity.

We regret having to proceed further. The work before us is not a mere collection of speculations which, if lacking evidence and incapable of being put to the test of sober experimentation, are certainly curious and possibly suggestive; it contemplates a social revolution wilder than was ever dreamt of by Nihilist or Communard. The chief points of this new Charter are "woman's rights" in the most exaggerated form, involving not merely equality, but the subjugation of the male sex, and, secondly, the emancipation of animals. This latter point requires certainly

the abolition of the slaughter of animals for food, feathers, hides, &c. If we do not mistake the authors, the destruction of life in self-defence and the compulsory employment of beasts of burden will also be restricted. If such is not the doctrine of the writers consistency requires that it should be.

The work is absolutely saturated with the virus of anti-vivisectionism. We quote the following passage:—"The adept can see the human shape in creatures under torture in the physiological laboratory. He can discern the potential form of a man, with limbs and lineaments resembling those of his tormentors, hidden within the outward form, and writhing and moaning under the lacerations of the knife. And he sees also the tiger and the devil rapidly developing within the still human forms of the torturers." Who is to draw the boundary between the "intuitions" of such adepts or "epopts" and the illusions of the fanatic and the neuropath? It would, we fear, be utterly useless to remind such morbid minds that nineteen-twentieths of what is called vivisection involves no more pain than that inflicted in the operation of vaccination, and that in many cases the "lacerations of the knife" are conspicuous by their absence. If they would admit the truth they must know that the total amount of death and pain inflicted upon animals in the cause of Science is but as the small dust of the balance. For one animal killed or pained in the pursuit of knowledge, thousands are slain or tormented in other causes, against which society raises not a whisper. Again, if we are not to eat animals we must extirpate them in self-defence. The struggle for existence, whether we accept it as an agent in the process of Evolution or not, is a stern fact, and it says to man, as to every creature, "destroy or be destroyed!"

In one sense we may thank the authors: physiological experimentation will be safe if, as they propose, sportsmen, flesh-eaters, and dog-fanciers are expelled from the ranks of its enemies.

We fear this book will make many converts to agnosticism and materialism, doctrines which, however unsatisfactory, are clear, wholesome, and luminous as compared with the visionary mysticism taught in these pages.

Experimental Chemistry for Junior Students. By J. Emerson Reynolds, M.D., F.R.S., &c. Part II.—Non-metals. London: Longmans and Co.

We have here a small manual in which the principal facts and the laws of Chemical Science are taught successively in a series of experiments adapted to the capacity of junior students. The author begins with air and nitrogen. A knowledge of air is

certainly important to the student, seeing that almost all chemical operations are performed in its presence, and the results are often modified in consequence of its action. But it may, we think, be fairly questioned by what right a substance admitted to be a mere mechanical mixture comes to be described among elementary bodies and their compounds. It might also be asked whether the first argument given to prove the air to be a mixture —viz., the inconstancy of its composition—can be taken as valid. It is conceivable that a definite chemical compound might be mixed with a variable excess of one of its constituents. In that case the ultimate analysis of the whole might fluctuate slightly, though we should be dealing with a compound somewhat contaminated.

The author observes that in tropical countries the oxygen of the atmosphere has been observed to drop suddenly as low as 20·3 per cent. This phenomenon, we understand, is not confined to tropical countries, but has been observed as far north as 40°, being attended by winds blowing in divergent directions from the place where the anomaly was recognised.

We are glad to note that the author calls attention to the true respiration of plants,—a process often overlooked in chemical manuals, because masked by assimilation of carbon. The reader is also taught that not all plants, but merely such as possess chlorophyll cells, are able to decompose the carbon dioxide of the air.

A very curious experiment here described is the liberation of hydrofluoric acid from pounded teeth,—say of sheep,—thus proving the presence of fluorine in the animal system and inferentially in vegetation.

The work may safely be recommended as clear, and it is scarcely needful to add accurate in its teachings.

A Systematic Handbook of Volumetric Analysis: or, the Quantitative Estimation of Chemical Substances by Measure, applied to Liquids, Solids, and Gases, adapted to the requirements of Pure Chemical Research, Pathological Chemistry, Pharmacy, Metallurgy, Manufacturing Chemistry, Photography, &c., and for the Valuation of Substances used in Commerce, Agriculture, and the Arts. By FRANCIS SUTTON, F.C.S. Fourth Edition, London: J. and A. Churchill.

BOTH volumetric analysis and the work before us have undergone noteworthy changes since the appearance of its first edition. Many procedures have been improved, many substances have been found capable of volumetric determination which twenty

years ago were thought quite outside its scope. In certain cases—*e.g.*, the determination of sulphuric acid—it even appears that the gravimetric method is inferior in accuracy as well as in despatch. The volumetric analyses of gases, a subject not touched upon in the first edition, is treated at very considerable length in the one now before us.

Under the analysis of water we read that the method of estimating nitrogen as ammonia is substantially that described by the late W. A. Miller ("Journal of the Chemical Society" [2], iii., p. 125). We presume the author means to say "the method of estimating that portion of nitrogen which exists in water as ready-formed ammonia." The language he actually uses would seem to include the determination of organic nitrogenous matter according to the process of Wanklyn, Chapman, and Smith. It must also be remarked that the determination of pre-existing ammonia or ammoniacal salts by distillation with sodium carbonate, and subsequent "Nesslerising," is popularly ascribed to the three chemists just mentioned. The author expresses himself very confidently—too confidently we fear—as to the trustworthiness of the means of determining the organic impurities in potable waters described in his Part VI. We are unable to share this confidence, and think that, so far at least, no perfect process for water-analysis has yet been devised. We know at least one signal instance where two identical samples of water, or rather two portions of one sample, on being sent through distinct channels to a very eminent chemist, gave results widely different, but in strict accordance with that chemist's known predilections. No chemical test seems capable of showing if nitrogen, whether determined by combustion or by conversion into ammonia, has been derived from a deadly or an innocent microbion. Water absolutely and permanently free from organic nitrogen is not found in Nature, and it is quite conceivable—or rather it is probable—that the sample containing the smaller quantity may be, from its quality, the more deadly. If we may venture to suggest, the water analysis of the future will turn more on microscopic examination and on "culture" experiments than on strictly chemical procedures. But progress in this direction is for the present barred to English chemists and physiologists. We do not see that the "hydrosulphite" process—the determination of the quantity of free oxygen present in any sample of water by means of the hydrosulphite solution of Schützenberger and De Lalande—is mentioned. This process is certainly practicable, but whether the free oxygen varies in regular inverse proportion to the organic impurities requires further examination. Our own observations leave the question doubtful, and we look forward with much interest to the results of others.

One of the changes which volumetric analysis has undergone is the substitution of atomic standard solutions for those called empirical. We are not sure that this change is in all cases an

advantage. There is a very considerable convenience in the use of solutions such that the number of degrees read off in the burette shows at once, without any calculation or reference to theories, the percentage of the body sought,—*e.g.*, of metallic tin in a sample of tin crystals. We fully admit that, to an analytical chemist in general practice, the atomic system has the tangible advantage of requiring a much smaller stock of standard solutions. But for a manager or foreman of some department in a chemical manufactory, who has to repeat say one or two determinations continually, we are old-fashioned enough to prefer the empirical system.

We find in Mr. Sutton's present edition a careful notice of the new alkalimetric indicators which have been introduced, with more or less success, in place of litmus. He gives the preference to Poirrier's "Orange 3," as being entirely unaffected by carbonic acid or sulphuretted hydrogen. Hence by its means samples of soda-ash, &c., can be titrated in the cold. Ammonia, also, does not interfere with its action, a merit not shared by phenol-phthalein.

Taken as a whole Mr. Sutton's work has no rival in the English language, and the present edition, being a distinct improvement on its predecessors, will give correspondingly greater satisfaction.

Magnetism and Electricity. An Elementary Text-Book for Students. By R. WORMELL, D.Sc., Head Master of the City of London Middle-class Schools. London: Thomas Murby.

THE production of a good elementary text-book in any department of Science is no easy task. The fullest knowledge of the subject-matter is, in itself, far from sufficient. There is also required an acquaintance with the art of presenting subjects to the mind of the pupil. Hence we are beginning to find that such manuals should be written by men who, in addition to the requisite scientific mastery, possess the experience of the practical educationist. The treatise before us is drawn up from this double point of view. In the outset it makes exceedingly small demands upon the pupil's knowledge; but by a series of experiments, at first exceedingly simple and easy, he is gradually led to a comprehension of the principles of electricity and magnetism, and to an understanding of natural laws.

We note with pleasure that the book—or rather the course of teaching for which the book serves as manual—is distinctly intended to be practical. The lecture experiments given in the

text are to be repeated by the student, and as he advances he is gradually introduced into the practice of the physical laboratory. Thus he will become not a mere reader, but a worker in Science, and, if his opportunities and faculties allow, he may finally stand forth as a discoverer or an inventor.

The author seems to recognise the great truth that Physical Science is needed in education for the discipline of the hand and the eye,—objects for which the utter impotence of classical and mathematical studies must be at once admitted. By discipline of the eye Dr. Wormell evidently means training in the art of observation—a point till lately completely overlooked in English education, primary as well as secondary. Admitting that different branches of Physics may serve equally well as agents of mental discipline, he thinks that electricity has peculiar claims and exceptional advantages, from the hold which it has recently obtained upon the attention of the general public, and from the important applications which it has recently received. However little a man's duties and tastes may bring him in contact with what are called scientific subjects, he will find it unpleasant to be ignorant of such inventions as the telephone, the microphone, Faure's accumulator, &c. It is scarcely too much to say that a person to whom these novelties are unknown or unintelligible will find himself as much perplexed in modern society as would a man ignorant of Greek and Latin in the days of incessant classical quotations.

From its clearness of exposition and arrangement, as well as from the fulness and systematically progressive character of the experimental evidence set forth, we feel warranted in giving this work our warm recommendation. The chief deficiency we note is in the index. A person running his eye over it might be led to the mistaken conclusion that, *e.g.*, Geissler's tubes, Wheatstone's bridge, and other recent devices, had been overlooked.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

"HAUNTED HOUSES."

To the Editor of the Journal of Science.

SIR,—I used to read with a friend, a medical student in the surgery, after business hours, and at times indulge in a little private dissection upon small subjects. While so engaged one night we were startled by the private surgery bell, upstairs, being very violently rung. There being only the old housekeeper in the house except ourselves, and she had gone to bed some time, we were puzzled to account for it, as of course there was no one in the room when we went in. This went on for several nights, and always between 12 and 1 p.m.

Not believing in ghosts we determined to watch, one upstairs and one down. Nothing occurred for some time; the bell-ringing stopped. At last one night while my friend, who was upstairs, was watching, he saw several mice come out of a hole and run along the wire which ran across the passage-wall, thus causing the wire to vibrate the bell.

Our work, the time, and regularity with which this occurred, would have made it a good case for a haunted house if the cause had not been discovered.—I am, &c.,

A. J. D.

35, Lewisham High Road, New Cross,
February 26, 1882.

CRUELTY TO ANIMALS.

To the Editor of the Journal of Science.

SIR,—At the request of my friends I write to correct you—if, indeed it be worth while—in regard to the error under which you

appear to labour concerning my opinions and practice. Had your critic cared to enquire on the subject, he would easily have learnt that, having been for twelve years a vegetarian, and a well-known writer against every phase of cruel sport, as well as against feather and fur wearing,—which articles I never buy for myself under any pretence,—his strictures on my supposed inconsistency fall very wide indeed of their mark. Your critic will do well to buy, beg, or borrow my little book entitled "The Perfect Way in Diet," wherein he will find arguments and pleadings galore against slaughter-houses, bird-trapping, seal-hunting, leather-wearing, and all other mal-practices in regard to animals. And, for the future, let him acquaint himself with the truth about those whom he assails before laying to their charge "things that they know not."—I am, &c.,

ANNA KINGSFORD, M.D.

The above communication, which we print as a curiosity, cannot be more truthfully and more severely characterised than as typically anti-vivisectionist, at once in its tone and in its line of assertion. Mrs. Kingsford, M.D., of whose very existence—not to speak of her "opinions," her "practice," and her writings—we were not aware prior to her recent outbreak in "Light," is not pronounced personally inconsistent, and hence her letter is simply an impertinence. If the lady in question makes use of beasts of burden, even without the bearing-rein, she is party to a custom involving more pain and "cutting up alive" than does physiological research. If she eschews animal food, "sport," fur and feather wearing, and the use of leather, her fellow-agitators and the public whom she is trying to influence do not. Hence the movement against experimentation on animals is inconsistent, and has logically no *locus standi*. Yet we do not see that Mrs. Kingsford called attention to this truth, or exhorted her hearers to quit their glass houses before beginning to throw stones. As our critic has not departed by a hair's breadth from that fairness which we have always endeavoured to observe even to anti-vivisectionists, we decline on his behalf the advice so naïvely tendered. Our readers may as well be informed that our correspondent is a believer in metempsychosis. She is reported in "Light" to have recently said that "she was beginning to recollect her former incarnations, but they were not such as she would like to make public. One of them filled her with shame and horror whenever she thought of it." Perhaps, if her belief is well founded, she will in some higher state of existence look back upon her anti-scientific orations with little complacency.

THE EDITOR OF THE JOURNAL OF SCIENCE.

EVOLUTIONIST VIEWS OF BEAUTY.

To the Editor of the Journal of Science.

SIR,—Your contributor Mr. Ram, in his attempt to account for our sense of beauty on Evolutionist (or rather on Natural Selectionist) principles, remarks—"The love of mountain scenery which some men possess records the fact that their ancestors were benefitted by such a taste which led them to dwell in localities least accessible to the foe." How does the writer, then, account for the fact that the love of mountain scenery is very modern in its origin, and is rapidly increasing, whilst if we look back even a couple of centuries we find mountainous regions pronounced dismal, desolate, and horrid.—I am, &c.,

DOUBTER.

Sir W. Thomson's communication in our next.

NOTES.

M. E. de Cyon (" Comptes Rendus ") has examined the influence of high atmospheric pressures upon animal life. He finds that they modify sensibly the normal relations of the tension of the gases contained in the blood. This action is exerted upon the circulatory and respiratory systems. Pure oxygen is not a special poison for the organisms, and animals die in it because the carbonic acid (the chief excitant of the vasomotor and respiratory centres), being sensibly diminished, the circulation and respiration are arrested. The movements of the heart are quickened at first because the oxygen (the normal excitant of the nerves and the accelerating centres) augments their activity, whilst the absence of carbonic acid diminishes the moderating action of the pneumogastric nerves.

M. C. Gessard (" Comptes Rendus ") finds that the blue and green colouring-matter which sometimes appears on the dressing of wounds is due to pyocyanine, which on oxidation passes into a yellow, pyoxanthose. Pyocyanine, like the ptomaines, reduces potassium ferricyanide.

M. Bjerknes and M. Decharmes have both succeeded in imitating electric action hydro-dynamically. The former, by means of bodies vibrating in water, reproduces the phenomena of static electricity and of magnetism inversely. The latter, experimenting with liquid currents, finds a direct analogy between hydrodynamic phenomena and those of electro-magnetism and induction.

M. Laveran some time ago discovered on the blood of ague-patients a peculiar microbion, *Oscillaria malariæ*. M. H. Richard, in a communication to the Academy of Sciences, traces the development of these parasites, which live in the red blood globules and destroy them.

Mr. Grant Allen (" Fortnightly Review "), in a notice of the autobiography of Sir C. Lyell, makes the following happy remarks :—" He luckily escaped the conventionalising and stereotyping drill of our public schools : he was never put through one of those dismal mills for crushing out individuality into which we turn most of our best material, so as to grind it down to the Procrustean measure of Ovidian elegiacs and Eschylean trimeters. . . . He was spared the brutal influence of ' compulsory foot-ball ' which would have been substituted for the pursuit of Nature in a modern public school." We regret that Mr. Grant

—perhaps in compliment to the *genius loci*—should have thought fit to season his otherwise admirable article with party politics.

The "Psychological Review" gives a remarkable "ghost story," but without the details which would be required for its verification. This "Review" also shows very prominent political leanings.

Dr. Nagorski has measured the capacity of the lungs of 630 boys and 314 girls in the schools of St. Petersburg. The volume is in boys 65 c.c. per kilo. of the weight of the body, and in girls 57 c.c. The weight of children under 15 years is proportional to 2·15 of the height.

Mr. Herbert Spencer, long forgetful of the maxim that the philosopher's position should be "higher than on the battlements of party," has at last formally come forward as a political agitator. Perhaps thinkers in thus acting are swayed by the same motives which lead the "minister of all denominations" to turn sensationalist, and the pharmaceutist to vend quack medicines and cigars. Nevertheless they are thereby committing suicide. Agitations and "movements" are to discovery and research what the *Phylloxera* is to the vine.

Dr. W. Flight ("Geological Magazine") gives some instances of meteorites which have been found intensely cold on falling.

Miss M. A. Hardaker ("Popular Science Monthly") shows on physiological grounds, that the difference of intellectual power in the two sexes is due to permanent conditions, and not to artificial arrangements.

W. D. Le Sueur ("Popular Science Review") writes—"Before we could affirm grossness or anything else of matter, we should have to get some of it and compare it with something that was not matter, but which yet could be legitimately compared with it.

F. Hildebrand ("Das Ausland") shows that annual plants are most numerous where a fairly long hot season alternates with a cold one. In equatorial regions, and the sub-arctic and arctic zones, the vegetation is chiefly perennial.

MM. Dehérain and Maquenne ("Annales Agronomiques") find, from repeated experiments, that the growth of plants—*e.g.*, in conservatories—may be accelerated by means of an atmosphere abnormally rich in carbonic acid.

H. A. Pagenstecher, in a discourse on the Cervidæ delivered before the Natural History and Medical Association of Heidelberg, pronounced that family a model field for the study of descent and adaptation.

Drs. Reynard and Blanchard (Société de Biologie) have measured the power of the masseter muscles of the crocodile as

compared with those of the dog. The latter exerts a power of 8·25 kilos. per kilo. of its own weight, while in the crocodile the power exerted rises to 12·8 kilos.

M. Lecoq de Boisbaudran has exhibited to the Academy of Sciences a specimen of a curious violet colouring-matter developed on the surface of starch-paste, especially if exposed to the vapours of acetic acid.

M. Filhol ("Comptes Rendus") concludes that Campbell Island has never been in connection with New Zealand, its fauna, present and fossil, being totally distinct.

It is stated that during the recent season of high barometric pressure the sea-level was depressed about a foot at Antibes, and continued so for a fortnight. On the summit of the Pic du Midi temperatures as high as 68° to 69° F. were registered from January 8th to January 20th. During the exceptional calm in England and France, the north of Norway suffered from unusually violent and continued tempests.

An instrument closely approaching the telephone is said to have been invented in the seventeenth century, by one Grimmelshauen, a soldier in the service of the Bishop of Strasburg.

Believers in metempsychosis would do well to examine whether their supposed recollections of prior lives are not simply cases of hereditary reminiscence.

M. Vulpian ("Comptes Rendus") criticises the views of M. de Lacerda on the value of potassium permanganate as an antidote to snake-poisons. He shows that the bite of *Bothrops Jacarandi* in Brazil is not always deadly; he proves that the injection of a solution of permanganate into a vein is fatal, and that if it merely passes into the subcutaneous cellular tissue it will be decomposed, forming a clot of hydrated peroxide very near the point of injection, and being thus prevented from penetrating far. The poison, on the other hand, is not thus decomposed. He does not call in question the alleged character of the poison as being not a true chemical agent, but a ferment.

In the introductory chapter of the "Manual of the Infusoria," by W. S. Kent, now in course of publication, the following appears, and should certainly be made more public than it is likely to be as a mere footnote in a very extensive work:—"In association with the discoveries of Leeuwenhoek here recorded, it is worthy of remark that a cabinet of the microscopes, to the number of twenty-six, as self-constructed and employed by that investigator, and consisting of simple doubly-convex lenses, were originally presented by him to the Royal Society of England, but have long since been lost sight of. The latest tidings of them would appear to have been furnished by Mr. Henry Baker, who in his work 'The Microscope made Easy' [p. 7, note], published

in the year 1785, attests to having had these glasses under examination away from the Society's premises, and at his own private residence. The recovery of such precious heir-looms, and the reconsignment of the same to their former custody, or among the series of optical instruments belonging to the Royal Microscopical Society, where perhaps they would be even more highly prized, is a consummation most devoutly to be wished, and may possibly be helped forward by this notice." The microscopes and their accompanying apparatus, as made by Leeuwenhoek, are described in Hoole's translation of his works, vol. ii., p. 217, and figured on plate 17.

Vivisection and Cynolaters.—We extract the following paragraph from the "Medical Press and Circular":—"An attempt was made on Saturday last, by Miss F. P. Cobbe, to depose Mr. G. Fleming, President of the Royal College of Veterinary Surgeons, from his seat on the Committee of Management of the 'Home for Lost and Starving Dogs.' The reason alleged was that Mr. Fleming had published an article in demonstration of the benefits conferred on animals themselves by vivisection. We can quite understand the bitterness with which anti-scientific enthusiasts regard the rapid growth of public opinion in favour of vivisection, since the attempt has been made to put the real state of the case before the world by qualified authorities. Of course the amendment proposed by this lady was ignominiously defeated."

The following remarks taken from a contemporary, though more especially levelled at pharmaceutical examinations, are true in a far wider sense:—"To get through is the main thing; not the possession of much knowledge. Private study is not of much use. It is too lengthy, and a man actually studies too much. A cramming school is the thing, where the ass is soon able to roar like the lion."

Prof. Marsh is criticised in the "American Naturalist" for failing, in his work on the classification of the Dinosauria, to recognise the labours of others and to credit others with their own discoveries. He assigns to Prof. Huxley the merit of showing the bird-like affinities of the Dinosauria, though this had been done at least a year earlier by Prof. Cope.

We regret having to record the premature death of Sir C. Wyville Thomson, late Professor of Natural History at the University of Edinburgh, and Chief of the Scientific Staff of the *Challenger* Expedition. Though nearly six years have elapsed since the return of the Expedition, the task of arranging the multitudinous specimens and drawing up the reports has not been completed. The deceased, who was only 52 years of age, had held successively professorships at Aberdeen, Cork, and Belfast, and had been engaged on the dredging expeditions of the *Light-*

ning and *Porcupine* before his appointment at Edinburgh. His contributions to the Transactions of learned societies are numerous and important. Whilst paying our last tribute to the memory of this indefatigable worker in Science, we cannot refer without pain to the unseemly character of the dispute concerning his successor. It appears that what is locally known as "soundness" is considered of greater weight than merit and efficiency.

M. A. Raffray ("Comptes Rendus") gives a view of the geographical distribution of Coleoptera in Abyssinia. In the littoral zone, an arid plain, the Coleoptera belong almost exclusively to Saharian types, the Tenebrionides predominating. In the interior valleys the types are Senegalian. Among the characteristic forms are *Tefflus*, *Galinta*, *Casnonia*, *Heliocopris*, many Cetoniadæ,—including *Goliathus Pluto*, *Eudicella Chloe*, and *Campsocephalus Horsfieldianus*,—some fine Buprestidæ, Cerambycidæ, and a great variety of Chrysomelidæ. On the table-lands most of the Coleoptera are peculiar; some have analogies with Natal, and some with the Mediterranean basin. There are few Longicornes, Buprestidæ, and Cetoniadæ, but many dung-feeding Lamellicornes and Carabs, many of the latter analogous to those of Syria and Southern Europe. In this zone there are numerous Paussides. In the fourth or subalpine zone the predominant forms are distinctly European, the chief exception being an aberrant *Calosoma* (*C. caraboides*). Among eighteen mollusks from the same zone nine belong to African and nine to European types.

Prof. Schmich ("Naturforscher") attributes, like Adhemar, the changes in the land- and sea-level to alternations in the latter affecting the northern and southern hemispheres in semi-periods of 10,500 years. The more flooded hemisphere has its glacial epoch, with an oceanic climate; the less flooded has its warm epoch, which is approaching in the northern hemisphere.

M. S. Jourdain ("Comptes Rendus") shows that in the starfishes the supposed heart and the vascular circles are merely the genital passages and annexed glands.

M. Marey ("Comptes Rendus") announces that he has succeeded in reproducing photographically the successive movements of a bird in flight. With a specially modified apparatus he is able to take twelve successive images per second—the time required for each being from 1-700th to 1-1500th of a second, according to the weather.

J. Reinke ("Berlin Berichte"), in replying to HH. Loew and Bokorny (*see* "Journal of Science," 1882, p. 152), contends that protoplasm is not a "body" in the chemical sense of the word, but an organism. He also shows that the reducing power is no fundamental and universal difference between living and dead cells, since it is wanting or doubtful in animal cells, the cells of Fungi and of the roots of *Pisum* and *Zea*.

M. Fischer gives ("Petermann's Geograph. Mittheilung.") an essay on the distribution of the date-tree. It can bear a winter temperature as low as 23·9°, and even the contact of snow for a day or two. To ripen its fruits it requires a mean summer temperature of at least 79° F., a dry air, and a clear sky. Its northern limit as a fruit tree is given by the isotherm of 70° F., and as an ornamental tree by that of 61° F.

"Ciel et Terre" describes the showers of dust so common in Italy. They occur generally in calm weather after a sirocco. The sky takes a reddish tint, the barometer falls, and the temperature rises. The dust is of a brick-red colour, of an acid reaction, and contains iron, partly of terrestrial and partly of cosmic origin. If accompanied by rain it injures vegetation by its causticity.

Mr. J. A. Wanklyn, writing in a lay paper, impugns the validity of the scientific evidence in the Lamson case.

Out of every hundred anti-vivisectionists ninety-nine are quite willing to get rid of vermin by poison. But if vermin are poisoned to solve an important judicial question, as in this very Lamson case, we hear shrieks about "violationism," "orgies of diabolism," and the like!

M. Decharme ("Comptes Rendus") has succeeded in reproducing, by means of liquid currents, the coloured rings of Nobili as obtained by electric currents.

Diphtheria—a disease which, by the way, according to the "New York Medical Record," may be communicated by cats—has been ravaging Bloemfontein, South Africa. Many cases proved fatal within twenty-four hours.

In the Department of the Seine there have been, from November 1st, 1880, to November 1st, 1881, 641 cases of rabies in dogs: 153 persons have been bitten, of whom 21 have died of hydrophobia.

An American contemporary suggests that the navies of all powers might, in time of peace, contribute much to scientific exploration without any sacrifice of efficiency and without appreciable outlay.

Dr. Brown-Sequard ("Comptes Rendus") shows that in the guinea-pig the results of accidental post-natal lesions may be transmitted for several generations.

Dr. J. F. Snyder ("Kansas Review of Science") contends that the mound-builders and miners of North America were not a distinct and vanished people, but were of the same race as the Aborigines found by the first European settlers.

ERRATUM

Footnote at bottom of p. 148, *for* "insignificant" *read* "significant."